AMATEUR RADIO

73

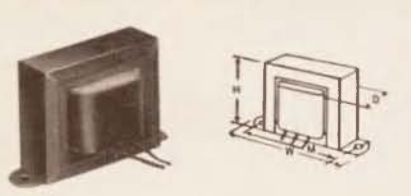
January 1963
A Teensy
40¢

REPLACEMENT TYPE TRANSFORMERS & REACTORS

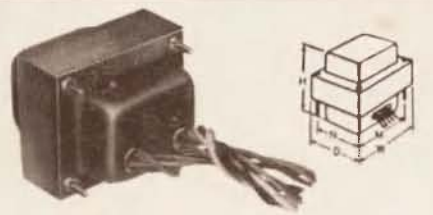
PIONEERS IN MINIATURIZATION

Thirty years of pioneering by UTC's research, design, and engineering staffs assures you quality and reliability unexcelled in the industry. UTC's line of stock and special custom built items covers virtually every transformer and filter requirement for both military and commercial use.

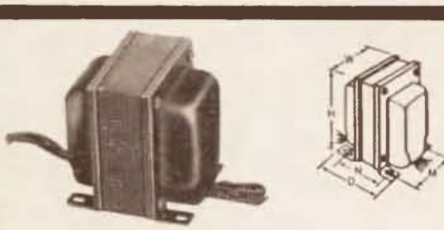
UTC replacement type transformers, here described, (Pri. 117 V. 50/60 cycles) provide the highest reliability in this field. All units are low temperature rise, vacuum sealed against humidity with special impregnating materials to prevent corrosion and electrolysis. Shells are finished in attractive high lustre black enamel.



CHANNEL TYPE



DOUBLE SHELL TYPE



VERTICAL SHELL TYPE

CHANNEL FRAME FILAMENT/TRANSISTOR TRANSFS.

Pri. 115 V 50/60 Cycles—Test Volts RMS: 1500

Type No.	Secondary	W	D	H	M	Lbs.
FT-1	2.5 VCT-3A	2 7/8	1 1/2	1 11/16	2 3/8	3/4
FT-2	6.3 VCT-1.2A	2 7/8	1 1/8	1 11/16	2 3/8	3/4
FT-3	2.5 VCT-6A	3 5/16	1 7/8	2	2 13/16	1
FT-4	6.3 VCT-3A	3 5/16	1 7/8	2	2 13/16	1
FT-5	2.5 VCT-10A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-6	5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-7	7.5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-8	6.3 VCT-8A	4	2 1/2	2 5/8	3 9/16	2 1/2
FT-10	24 VCT-2A or 12V-4A	4	2 5/8	2 5/8	3 9/16	2 1/2
FT-11	24 VCT-1A or 12V-2A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/8
FT-12	36 VCT-1.3A or 18V-2.6A	4	2 5/8	2 5/8	3 9/16	2 1/2

Taps on pri. of FT-13 & FT-14 to modify sec. nominal V, −6% +6%, +12%

Type No.	Secondary	W	D	H	M	Lbs.
FT-13	26 VCT-.04A	2 1/8	1 3/8	1 1/4	1 3/4	1/4
FT-14	26 VCT-.25A	2 7/8	1 3/8	1 11/16	2 3/8	3/4

DOUBLE SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-101	275-0-275	50	2A	2.7A	3	2 1/2	3	2 1/2	2	2 1/2
R-102	350-0-350	70	3A	3A	3	2 1/2	3 5/8	2 1/2	2	3 1/2
R-103	350-0-350	90	3A	3.5A	3 3/8	2 7/8	3 13/16	2 13/16	2 1/4	4 1/2
R-104	350-0-350	120	3A	5A	3 3/4	3 1/8	3 7/8	3 1/8	2 1/2	5 1/2
R-105	385-0-385	160	3A	5A	3 3/4	3 1/8	4 5/16	3 1/8	2 1/2	7

VERTICAL SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-110	300-0-300	50	2A	2.7A	2 5/8	2 13/16	3 1/4	2	1 3/4	2 1/2
R-111	350-0-350	70	3A	3A	2 5/8	3 7/16	3 1/4	2	2 3/8	3 1/2
R-112	350-0-350	120	3A	5A	3 5/16	3 11/16	4	2 1/2	2 5/16	5 1/2
R-113	400-0-400	200	3A	6A	3 7/8	4 5/16	4 5/8	3	3 1/8	8

CHANNEL FRAME FILTER REACTORS

Inductance Shown is at Rated DC ma—Test Volts RMS: 1500

Type No.	Induct. Hys.	Current	Resistance Ohms	Dimensions, in. W	D	H	M	Wt. Lbs.
R-55	6	40ma	300	2 3/8	1 3/8	1 3/8	2	1/2
R-14	8	40ma	250	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-15	12	30ma	450	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-16	15	30ma	630	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-17	20	40ma	850	3 5/16	1 5/8	2	2 13/16	1
R-18	8	80ma	250	3 5/16	1 5/8	2	2 13/16	1
R-19	14	100ma	450	3 3/4	1 7/8	2 5/16	3 1/2	1 1/2
R-20	5	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
R-21	15/3	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
R-220	100/8 Mhy 25/2 Mhy	2.5A 5A	.6 .16	3 3/4	2	2 5/16	3 1/8	1 1/2

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73

Magazine

Wayne Greane, W2NSD
Editor, etcetera

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de W2NSD/1

Never Say Die

New Year . . . reminiscences. I remember back to our first office, two tiny rooms in the wilds of Brooklyn over a fruit store and delicatessen. Virginia and I did everything, including the subscription stencils. We worked seven days a week, sixteen hours a day, and were always so far behind we couldn't see how we could ever catch up. We took two hours off in January and got married. By April we had caught up the two hours and gotten enough ahead to manage a terrible seven room apartment, most of which was devoted to office.

Outside of a few fast trips to ham conventions we were pretty well chained to the office. By the next April we had an employee to take care of the subscriptions and make and occasional pass at the books. We took a month off and drove all over Europe, our first vacation. This was so much fun that we decided to try our darndest to put on a ham charter flight to Europe in 1963.

The day and night operation of our busy office on the floor above the landlord shortened our lease amazingly and we discovered shortly after our return from Europe that even though we were months behind in our work that moving time was only a few weeks away. We had been dreaming of getting out of New York ever since we had started the magazine and this seemed like a good time to make the move. We were so far behind in everything that it really didn't matter if things got worse. Authors were screaming for decisions on their articles, advertisers were getting very impatient with our almost non existant bookkeeping, and the mail to be answered lay in huge piles everywhere.

A vague idea of the horror of the move has already been described in my editorial. The full impact of it can only be appreciated by taking a guided tour through our new headquarters and seeing the incredible amount of debris that was moved. Counting everything we have about 35 rooms here, all are in use and many quite full!

What of 1963? Since moving up here we have expanded our staff to include Lenny Tamulonis W1MEL, an artist/draftsman who helps make up our covers, works on the various books, booklets and other publications that we publish (ATV Bulletin, Care & Feeding of Ham Clubs, etc.), special promotions to advertisers, distributors, and subscribers, and hundreds of other jobs. He also is a whiz on 20M CW and helps keep the HQ station on the air and active. Val Barnes K1APA tries to keep up with the subscriptions and orders for books, booklets and other stuff we peddle. He also tries to keep the keeper of the subscription stencils down in Brooklyn up to date. The Brooklyn end just about broke down recently when almost 10,000 renewal subscriptions came in and swamped everything. Val had to placate several hundred "Where is my October issue?" complaints while things got caught up.

Pamela, WN1???, a real cutie, bookkeeps.

Virginia still handles all of the processing of the articles, layout of the magazine, proofreading, coordination of typesetting, drafting of circuit diagrams, specifying of engravings, setting up of many of the ads, and hundreds of other jobs as well as looking after the house and food supply. I con advertisers into trying 73 and hope that you'll back me up with some buying of their products or at least requests for information to make them think that you might buy something. Other little tasks fall to my broad shoulders: signing pay checks, reading manuscripts, solving unsolvable problems, and generally managing the headquarters and magazine.

In the next few weeks we will be expanding a bit more with the addition of a circulation manager. Bob, W5HJV, will be moving up here from Oklahoma to see what he can do about coordinating our efforts to get the best possible sales from newsstands, parts distributors and subscription. We're still looking for someone to check out new equipment, keep the headquarters station on the air, set up more antennas, write special articles, and answer technical questions that arise.

This year looks pretty good. The Institute of Amateur Radio has been founded, the trip to Europe is taking shape for the fall, 73 readership is increasing by leaps and bounds while many other ham publications are just holding their own or suffering catastrophic losses of circulation. We have some fabulous articles coming up and many more promised. We've

carefully scheduled the arrival of the jr. op. for about April first so he'll (?) be old enough to appreciate the October flight. We won't be moving to our new mountaintop headquarters location until June.

Institute Membership

Consistent with the Institute policy of encouraging amateurs to improve their technical knowledge we have established different classes of membership which will reflect the status of the member as measured by his class of amateur license. SWL's and other non-licensed members are Participating Members, Novice licensees are Junior Members, Technician and Conditional licensees are Associate Members, General Class are Regular Members, Advanced Class licensees are Full Members, and Extra Class licensees are Senior Members.

Charter Members should all have received their Membership Cards and all should have the IAR Gold Seal on them. This Gold Seal will be placed on all renewal memberships where there has been no lapse of membership. We have some interesting benefits for Charter Members, but we cannot divulge them yet because this issue of 73 will be distributed a few days before the deadline for Charter Membership closes on December 31, 1962. We'll let you know next month when it is too late to do anything about it. Note: LIFE subscribers to 73 will automatically be enrolled as Charter Members of the Institute.

Club Membership in the Institute of Amateur Radio

Amateur radio clubs may affiliate with the Institute for a one year period by submitting the following:

1) A complete list of the members, including calls, and the officers of the club. Indicate those that are subscribed to 73.
2) A registry fee of $2.00 must accompany the application.
3) A statement of ARRL or non-ARRL affiliation must be included.
4) A list of all annual or regular club events such as hamfests, picnics, dinners, etc., which would be of enough interest to be generally announced or which might require prize donations.

Advantages of club affiliation:

1) Members whose names and calls appear on the club rosters may subscribe to 73 Magazine, the official organ of the Institute, at a reduced rate.

(Turn to page 64)

A Nu 1¼ Meter Converter

Larry Levy WA2INM
1114 East 18th Street
Brooklyn 30, New York

Although it is claimed that it is as easy to build a 1¼ meter converter as it is to build a 2 meter converter, this is usually not the case. It is true that construction details are quite similar, but it is also true that it is harder to get a good noise figure. Most 1¼ meter converters have very poor image rejection (with the exception of those using coaxial lines, but these have very poor bandwidth and have to be retuned to cover more than a small section of the band) and a larger number of spurious responses than a lower frequency converter.

A close look at the design of these converters will reveal the same common faults in the design. 220 mc is the borderline in the design of converters. The frequency is too low to require the use of crystal mixers and cavities, although they *can* be used and are entirely practical. The frequency is also too high to successfully use some of the design features common to 6 and 2 meter converters. One of these is the use of a low frequency *if* output. With an output of 7 or 14 mc, the tuned circuits don't have enough rf selectivity for satisfactory image rejection. There is also the disadvantage of a long multiplier chain for the oscillator. The average converter uses a crystal in the 30-50 mc range and multiplies 4 or 5 times. This results in many unnecessary spurious responses. I have actually seen the design for a converter for 1¼ meters that started with a 6 mc rock. Needless to say, the only things that will probably be heard on that converter are spurious responses and TV hash. I decided to build a converter that would have as few of these design faults as possible.

To keep the spurious responses and images to a minimum, I decided to use the highest *if* possible. There was a choice between 6 or 2 meters and I chose 2 meters because of the smaller number of times the crystal frequency would have to be multiplied. If a 6 meter (or any other) *if* is desired, the only changes necessary are the frequencies of L3, L4, L5 and the crystal. This principle could be applied to another band successfully. For example, I don't know why most 2 meter converters don't have an *if* of 6 meters for those amateurs who already own a 6 meter converter or receiver. Another reason why 2 meters was chosen was that I already had a good low noise nuvistor converter (see 73 Aug., 1961) for 2 meters and, in all probability, so does every other amateur who is interested in 1¼.

By using one or two good low noise rf stages ahead of a low noise mixer and then feeding the output into a low noise 2 meter converter, the performance of the entire receiver should be excellent. Nuvistors were chosen for the rf amplifiers and mixer because of their excellent noise figure, their high transconductance, their performance at 220 mc, and their low cost and high uniformity. The grounded grid configuration is the least critical, has the best stability, and has the lowest noise figure. The gain-per-stage is not very high, so two rf stages are required before the mixer to give a good noise figure, although with the low noise mixer and the low noise stages after the mixer it is not too necessary to have much rf gain before the mixer. The antenna lead is connected directly to the cathode of the rf amplifier(V1), the low impedence cathode being a close enough match to the line to not require additional matching. An Ohmite Z-1235 is used in the cathode circuit to block the rf while passing the dc cathode current. A three turn air-wound coil is used in the plate circuit. This coil(L1) is tapped about one turn from the cold end and coupled to the next stage with a 39 mmfd ceramic disc.

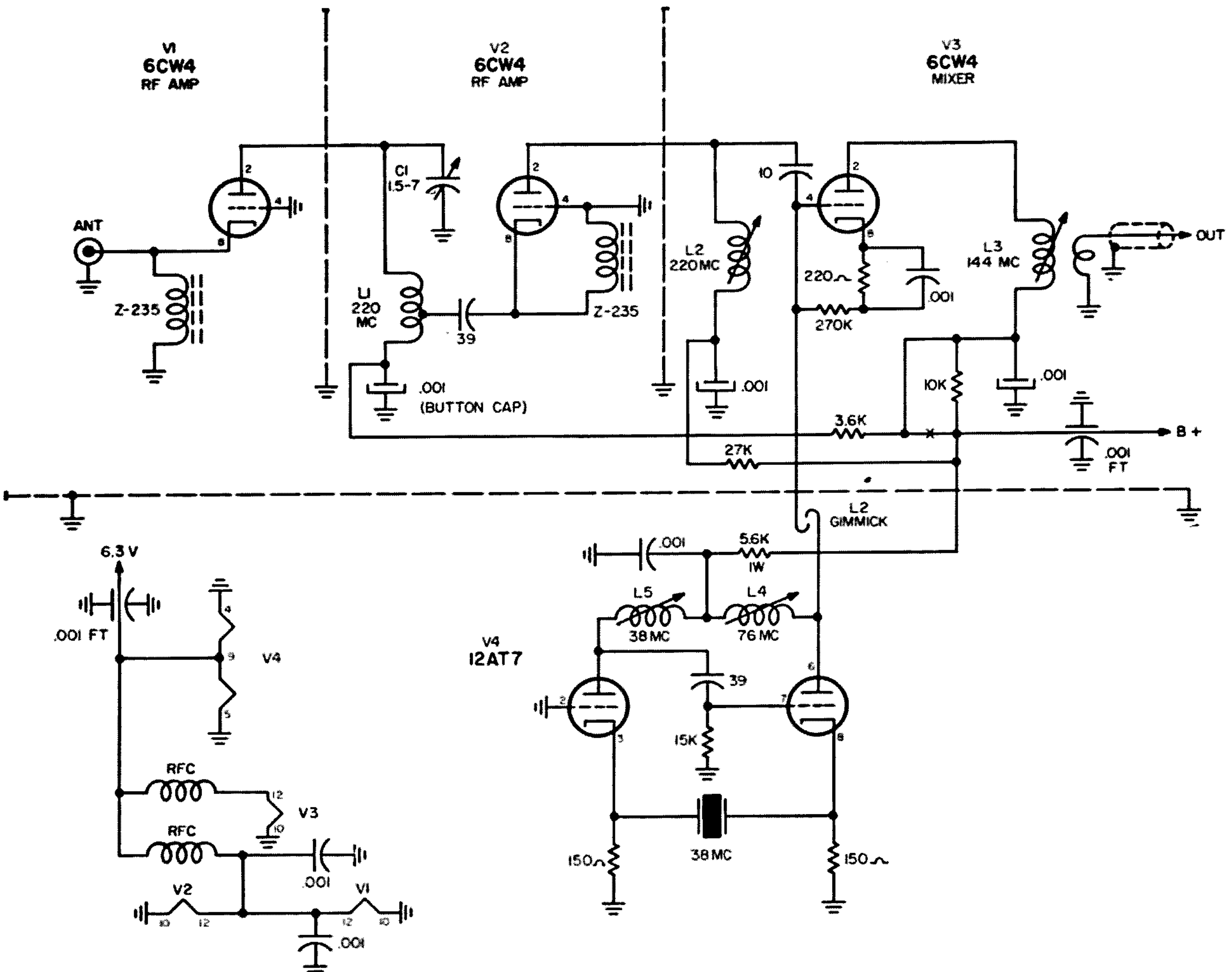
After the converter is completed, the tap on L1 should be adjusted for the best noise figure, moving the tap ¼ or ⅛ turn up or down and using a noise generator or some other means to obtain the best noise figure. L1 is tuned by a 1.5-7 mmfd ceramic trimmer (C1).

The second rf stage is similar to the first except the plate coil is not tapped and is slug tuned. The coil form used came from a discarded piston trimmer. It is about ¼" in diameter and has a brass slug. Any similar coil form can be used.

The mixer is conventional except for the fact that it uses a nuvistor. The oscillator is a modified butler circuit and it was chosen because of its stability and ease of construction. The crystal is a 38 mc 3rd overtone type mounted in a holder with flexible leads. This can be improvised if necessary and leads can be soldered to a holder such as the International FA-5 or FA-9. Care must be used when soldering to the crystal as excess heat can damage it. If you prefer not to solder to the crystal, a socket can be used.

The converter is constructed on a 4" x 6" piece of copper. This is mounted on a 4" x 6" x 3" aluminum chassis. All wiring is done on the copper plate. The four tubes are mounted in a straight line along the center of the chassis. The first rf amplifier tube is first, followed by the second rf stage, the mixer, and finally the oscillator. A shield is placed across the rf amplifier tube sockets to keep the possibility of self-oscillation to a minimum. A shield is also placed between the oscillator stage and the rest of the converter to minimize spurious responses. The shields are made from the tops of beer or soft drink cans. These cans have tops that are tin plated on one side and copper plated on the other. They are very easy to solder and are ideal for use as shields. The tops are cut in half for use as shields and are soldered between two screws mounted approx. 2" apart. These screws should be brass, which is easy to solder to.

Button condensers are used for bypassing the plate coils because they are the only type that will bypass this frequency effectively. At 220 mc, the inductance of ceramic discs make them less effective as bypass condensers. This is also true of two meters, where most ceramic discs start to lose effectiveness because of their inductance, but will still do a passable job as a bypass. Better performance can be obtained if button condensers are used. The surplus type button condensers will work fine in this converter (they are available for approx. 5-10c each) but if you are a perfectionist you can use new silver mica buttons. The buttons are soldered directly to the shields to minimize the leads on the coils. Do not try to



eliminate the leads entirely because they are part of the inductance of the coils. L1 should have a *total* lead length of 1 inch. L2 should have a ½" lead between the cold end of the coil and the bypass condenser and a slightly less than one inch lead between the coil and the plate pin of V2. The lead length on L3 should total about 1 or 1¼ inches. The lead lengths of coils L4 and L5 are not as critical, but should be as short as possible. A grid dip meter will be very helpful in determining the resonant frequencies of the coils, although the coil table is enough if the directions are followed carefully.

The output is taken from a 1 turn link wound over the cold end of L3. The link is connected to a length of RG-58/U with a connector on one end of the type used on the two meter converter. The other end of the coax is soldered to a terminal strip in the converter and connected to the link. No problems should be encountered with the wiring of the converter. A ⅜" hole should be drilled where C1 is mounted so that it can be adjusted from the top of the chassis. This will make the tune-up considerably easier. The rf chokes in the heater circuit are made from 20 turns of #30 enameled wire close wound on a ¼" form or high value 1 watt resistor. The choke is not critical and a Z-144 or any similar rf choke can be substituted. The rf choke isolates the rf and mixer tubes from the oscillator to keep the oscillator voltage from being coupled into the rf stages through the heater line, causing spurious responses. The heater and B voltages are connected through .001 mmfd feed through condensers. Gimmick capacitor C2 consists of two 1" pieces of insulated wire twisted together. If this results in too little injection, twist them together more tightly. If there is too much injection, untwist them slightly. The injection level is not very critical.

After the wiring is completed the next step is to try the converter and see if it works. The power can be taken from the receiver, the 2 meter converter, or a separate power supply. The converter requires about 100-130 v at approx. 30-40 ma and 6.3 v at 700 ma. With voltage applied and the tubes warmed up, couple a grid dip meter or absorbtion wavemeter to L5 and tune L5 for maximum output at 38 mc. Next tune L4 for maximum output at 76 mc. Tune L3 for maximum noise. Connect a weak signal source to the input and tune L1 and L2 for maximum signal. Using a noise generator (see 73, Dec. 1960 P. 37 for details on a very inexpensive one that will work fine) tune L1 and L2 for the best noise figure. Move the tap on L1 ¼ or ⅛ turn and see if the noise figure improves (after returning the coil). If it does, move it another ⅛ turn, etc., until the best noise figure is reached. If it does not improve when it is moved in one direction, move it in the other direction and repeat the above steps. Now repeak L3 to give the flattest response over the full 5 mc. It should be possible to get a flat response within a few db over the 5 megacycles of the band. Without the use of a noise generator it should be possible to get a noise figure of 5 or 6 db. This can be improved greatly by the careful use of a noise generator.

The results obtained from this converter were better than expected. The sensitivity is excellent and the level of images is so low that it is almost impossible to detect them. The number of spurious responses is lower than any 1¼ meter converter that I have heard. The converter costs less than any of the popular kits and the performance is hard to equal. Perhaps something like this will help to build interest in the 1¼ meter band and prove that it is as good as two meters.

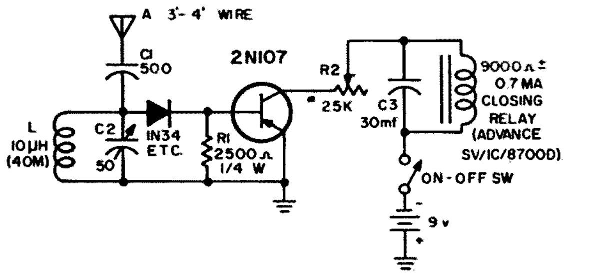
. . . WA2INM

RF Controlled Break-in System

Possibly many other CW operators as the author have searched in vain for a clean simple method of blanking their receiver to achieve break-in operation. The usual scheme involves a noisy click producing relay following the key which shorts the receiving antenna and/or reduces the receiver gain. The ideal scheme, however blanks the receiver only when there is rf on the transmitting antenna, thus serving also as part of the push-to-talk operation of the station. The "RF Controlled Break-in Switch" presented in this article meets exactly these goals with the minimum of cost and complexity.

The 'switch' is nothing more than a simple receiver except that instead of driving earphones, the "receiver" closes a relay. The 'switch' can be enclosed in a 3 x 4 x 5 in. box with a short whip antenna protruding and placed at a convenient place behind the receiver.

The LC_2 circuit can be designed for band switching (see Handbook; Misc. Data: cap,



ind, freq. chart). However in this case the 'switch' was designed for 40 meters exclusively. Once the LC_2 circuit is tuned for the middle of the band, it is not necessary to retune to each transmitting frequency due to the high impedance of L.

If another general purpose transistor T is used (such as 2N34, CK722) or a relay other than the one used here, the value of R_1 might require change in order to drop the idling current of T below the holding current of the relay. (The relay used was found to close at .6 ma. and release at .2 ma. and so R_1 was adjusted to give an idling current of .1 ma.). The resistor R_2 serves as a sensitivity control to conserve battery drain; its position depends on the distance between the transmitter and the 'switch.' Above all note: *not every relay will work;* only those with closing current of .4-.6 ma. will do the job.

The large electrolytic C_3 serves to hold down the relay during the transmission of CW characters and can be adjusted to the operator's CW speed by the formula: "Holding time in seconds = resistance of relay in ohms × capacitance of C_3 in farads." The contacts of the relay can be used to short the receiving antenna and/or cut the gain of the receiver (see Handbook: Keying and Break-in).

A 3 ft. piece of bus wire was used as an antenna although a nearby screen or a few turns around the coax feed line of the transmitting antenna would suffice. With the bus wire antenna it was found that the 'switch' would operate at a distance of 85 ft. from the transmitter.

. . . Charles R. MacCluer W8MQW

The NTSC Signal

for ham TV

Richard Taylor K2HQY
308 Stratford Road
Brooklyn 18, New York

Many hams seem to be taking the opinion that the easiest approach to Ham TV is by means of free-running oscillators and simple non-interlaced signals. While these methods will give quite good results the standard NTSC (National Television Systems Committee) TV signal is, in this ham's opinion, infinitely superior, just as easy to use and not at all difficult to understand if you take it step by step. Let's look at a simple NTSC-type signal and then see how to make use of it.

Let's start at the very beginning. By this time, most hams should be aware that in the TV camera light variations in the photographed scene are changed to similar electrical variations. Even if you think this process is pure sorcery, realizing this you've got a good start. Now how to use this mystical signal? Television receivers, like most machines are quite moronic and unless you tell them what to do at regular intervals they are no use at all. You have to supply some form of control. This is where the sync and blanking signals you've undoubtedly heard about come in. They act as policemen who give the recalcitrant set a good swift kick at appropriate times and in appropriate places to keep it in line. By combining the camera signal (called the video signal) and the sync and blanking signals we get a composite signal which can be fed to the set. It would, of course, be possible to transmit and receive each of these signals separately, but that would be kind of expensive wouldn't it? Hence the combined signal; it acts as its own policeman.

Let's go back to the camera again and build up our composite signal piece by piece. The process begins when the camera dismembers the scene into a series of horizontal lines which are then transmitted in time sequence, that is, one right after the other. Let's look at a typical TV scene (Fig. 1). Not so typical you say, well maybe not, but it will serve for our pur-

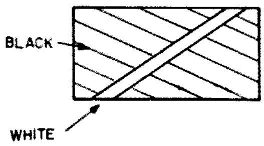


FIG. 1

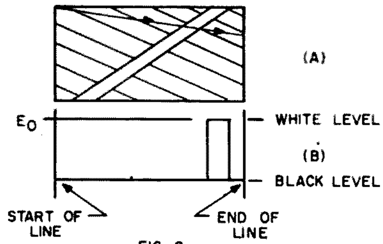


FIG. 2

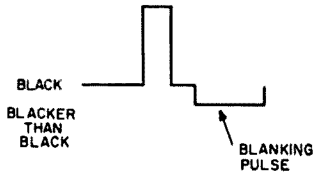


FIG. 3

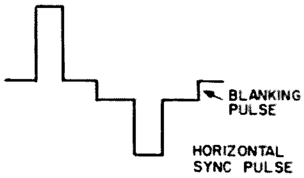


FIG 4

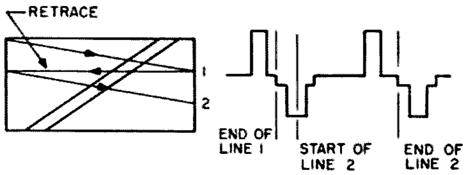


FIG 5

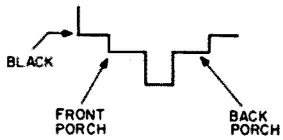


FIG. 6

T. MCGIRT

pose. Let's assume for simplicity that we will only use ten horizontal scanning lines. Starting from the upper left hand corner the camera scans to the right and down—but much faster to the right than down. Like Fig. 2(a). The signal from this scan is shown just below it in Fig. 2(b). The positive pulse corresponds to the white portion of the picture. The two levels are labeled as shown. At this point it is necessary to inform our imbecilic receiver that something new is going to happen. First we turn off the electron beam by mixing in a blanking signal which drives the signal into the so called "blacker-than black" region. This video plus blanking combination is commonly called a non-composite signal. The signal now looks like Fig. 3. With the electron beam safely off and out of the way we kick the horizontal oscillator once to make the spot scoot back across the screen to the left so it can start another line. Sync is added in Fig. 4. This new pulse is your horizontal sync pulse and is somewhat narrower than the blanking pulse so that we can be sure the electron beam is off all the while, and for some time after the horizontal oscillator has gone through its retrace act. We are now free to begin line two—see Fig. 5. Notice that the position of the "white" pulse has moved slightly to the left during the second scan. This is because the white line in the scene was reached by the scanning beam sooner in the second line than it did in line one. At the end of this line we add in the usual sync and blanking pulses. Those little "shelves" just to the left and right of the sync pulse, incidentally, are called the "front porch" and the "back porch" of the signal. (Fig. 6). The back porch is usually slightly larger (longer in time) than the front porch.

This same process now repeats itself ten times, each time the position of the "white" pulse moving slightly to the left until, in the tenth line, it is residing all the way to the left of the scanned line.

Like an English bicycle, this process has

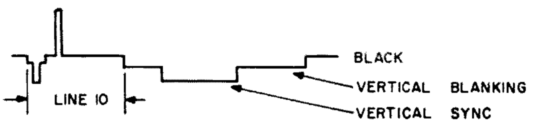


FIG 7

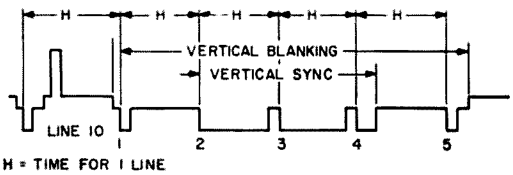


FIG. 8

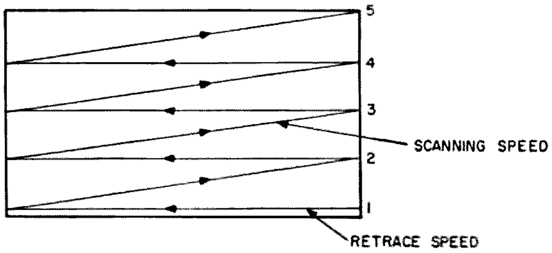


FIG. 9

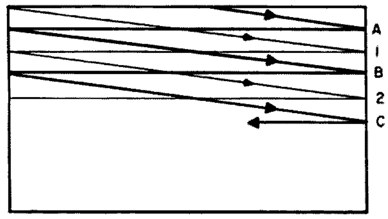


FIG. 10

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three speeds. The scanning beam runs across the screen at a moderate rate, scoots back across the screen during retrace at a tremendous rate, all the while creeping down vertically.

We have reached another critical point in our scanning process. It is time to move the scanning beam back up to the upper left hand corner of the screen. So, just as we added a horizontal sync pulse to make the beam retrace horizontally we now add a vertical sync pulse to make it move back vertically. As usual, we begin with a blanking signal to cut the picture tube off, called "vertical blanking". See Fig. 7. You will notice that these pulses are quite a bit longer than the horizontal pulses. The vertical retrace rate, being quite turtle-like compared to the others, takes a time equal to quite a few horizontal scanning lines. And what is the horizontal oscillator going to do all this time? Take off on it's own if we don't keep it in check. So we firmly apply control by modifying the vertical blanking and sync pulses by placing horizontal sync on top of vertical blanking and "serrating" the vertical sync pulse. Let's say it takes four horizontal lines for the vertical retrace to take place. Our composite pulse would then look like Fig. 8. Notice that horizontal oscillator is keyed (caused to retrace) on the trailing edge (the right hand edge, the one later in time) of the serrations. The reason for this is that it is a negative going pulse which operates the oscillator. The scanning beam moves up the screen about like Fig. 9.

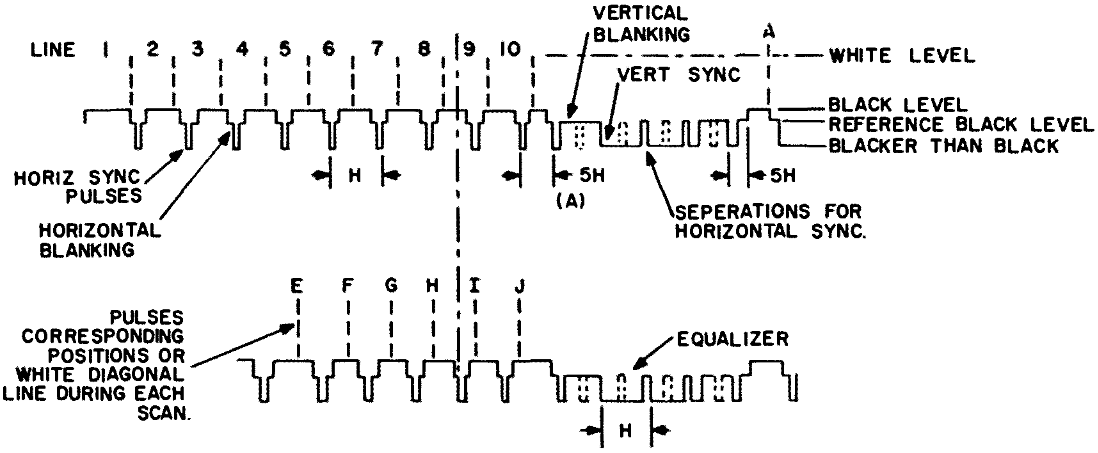
So we have come round robin. Having returned to the top of the screen the whole sequence can begin again. Here we have one kind of composite signal but you wouldn't want to use it would you? After all, with only ten scanning lines the picture would be fairly horrible. We say it would have poor vertical resolution. That is, if you were photographing a geometrical pattern of horizontal lines the greatest number of lines you could photograph would be ten, one for each scanning line. This is pretty poor. We see from this that our vertical resolution (the ability to resolve details which are horizontal) is highly dependent on the number of scanning lines used. The greater the number of scanning lines, the greater the vertical resolution and the better the picture. Horizontal resolution, on the other hand, is independent of the number of scanning lines used and depends on the frequency response of the system (How high a frequency can it pass? how narrow a pulse?). These names may seem backwards to you. If they do just remember that horizontal resolution is connected with the horizontal scanning operation and vertical resolution is connected with scanning in the vertical direction. Resolution is commonly measured in the number of lines (horizontal or vertical) that are clearly defined on the face of the monitor when viewing a test pattern. Two numbers specify the system. One for horizontal and one for vertical.

Let's talk about another problem. How many pictures are you going to present each second? Have you ever watched home movies? Did you notice anything that is not present in a theater presentation? The home movies probably had quite a flicker in them. Right? Your eye can remember that still picture for only so long before it fades. If the next picture doesn't come up fast enough a flicker will be produced. The eyes can be fooled though. By turning the light source on and off, say twice for each frame the eye will be fooled into thinking that twice as many pictures are being shown and the light source appears

constant. Something similar to this is done in TV.

The scanning process proceeds as before until we get to the middle of the tenth line. At this point the beam is blanked out and vertical retrace is initiated. Retrace now follows a new path, returning the beam to the upper left hand corner of the screen. When the scan for the next field is begun the beam remains blanked out until it reaches the center of the screen. At this point it comes on and the video is presented on the screen. Beginning the retrace at the middle of the last scan of the previous field has the effect of returning the scanning beam to a point slightly higher than it was at the start of the first field. The distance of vertical retrace is the same for each field but when retrace is begun early the beam does not get as far down the screen as it had the previous scan, so it ends up higher. The distance that it is higher is equal to one-half the distance between successive scanning lines of the same field. Because of this the scanning lines for the new field fall in between those of the old one. This is called interlaced scanning. Confused? Go back and read it again and think about it awhile—eventually it will make sense. Have a look at Fig. 10 to see how the two fields fit together. In the American standard system, each field consists of 262½ lines; two fields making a frame. The field rate being 60 cps (which is fast) eliminates flicker and the 262½ lines per field reduces the bandwidth required by a factor of two over that which would be required for a 60 cycle 525 line system with no loss of quality. Ingenious, huh? Our ten line composite signal now appears as shown in Fig. 11.

Now this is starting to look like those pictures you've seen of the composite TV signal in textbooks. There is just one more kind of pulse we must add in order for it to correspond directly. These are the so called equalizing pulses, or equalizers (shown dotted in Fig. 11). These are very narrow pulses which come at twice the horizontal scanning rate and so, fit midway between the horizontal sync pulses on the vertical blanking pulse (this is the only place they appear). My simple system (which is obviously not very practical) has room for only four equalizers but the standard American system uses 12 or 13, depending on which field you look at. The mechanism by which these equalizers operate won't be talked about here. Suffice to say that they serve to insure stable interlace. They make sure the two fields fit together exactly. One other thing you will find in the NTSC signal that is absent here is the presence of a number of otherwise



normal horizontal scanning lines that carry no video (called inactive lines). These follow both the vertical sync pulse and equalizers. These provide a kind of guard band to make sure the horizontal oscillator is operating stably before actually beginning the picture.

So that's the kind of signal that is used in broadcasting today. Amazing, isn't it? That vertical sync pulse hardly looks like one pulse anymore. It's there though, you just have to look for it.

Now that the system is not a mystery any more let's apply it to ham TV. To be sure, you can't be expected to buy a television sync generator (they run to four figures) but you sure can come by a used television set. We're going to steal sync from a local TV station and let them worry about maintaining the quality of the pulses.

Take a gander at Fig. 12 which is a block diagram of a system the author has been experimenting with. To get sync out of the set (and here I'm referring to the entire pulse train and not just horizontal or vertical sync) the audio stages were removed and replaced with a sync amplifier and output stage which would give about 4v into a 75 ohm load. This was done so RG-59/U could be used to feed the sync signal elsewhere. A 5FP7 was substituted for the original 10BP4 and a photomultiplier was mounted in front of the tube. The slide is placed on the face of the 5FP7.

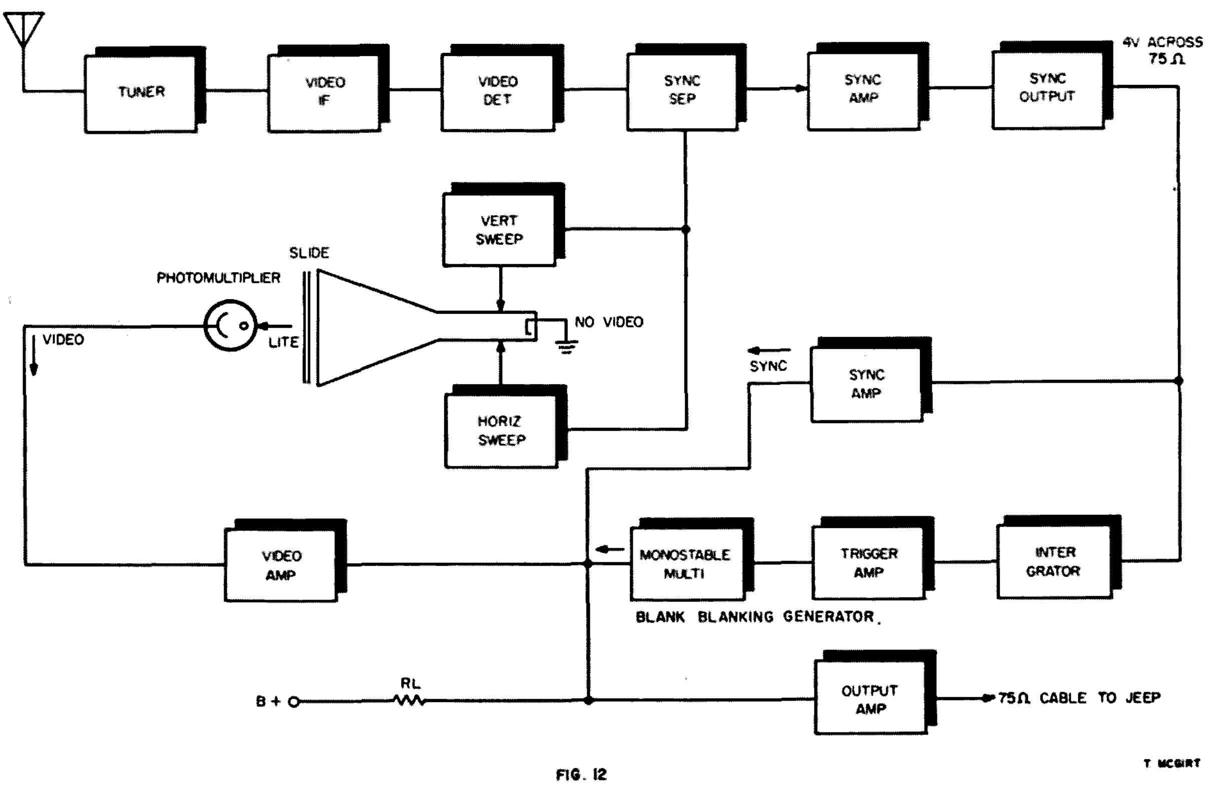


FIG. 12

Video from the photomultiplier is amplified and then mixed with sync from the TV set. Now it's not possible to get a good blanking signal from the sync separator in the set. While the absence of horizontal blanking caused little trouble, the absence of vertical blanking gave some beautiful retrace lines through the picture. The blanking generator was constructed to eliminate these lines. First the sync signal is fed through a three stage integrator as is found in most TV sets, the output pulse from the integrator is amplified and used to trigger a monostable multivibrator. Don't let that name scare you. This device just gives a nice square output pulse in return for each jagged one fed in. The pulse width was adjusted to blank the retrace lines over the entire screen. These three signals; video, sync and blanking are then mixed in a common resistor (a plate load in this case) and the composite signal fed to an output stage which in turn feeds the monitor, or "jeep" as its sometimes called. The results so far have been quite good although a lot more has to be done before the scanner is airworthy. The interlace obtained is good.

So there you have it. A way of getting good TV pictures on a ham type signal. The signal is non-standard due to the absence of horizontal blanking but it works quite nicely. That NTSC signal isn't so confusing after all is it? Now go have a look at a good book on television and see if the diagrams of the signal are still confusing. They shouldn't be.

. . . K2HQY

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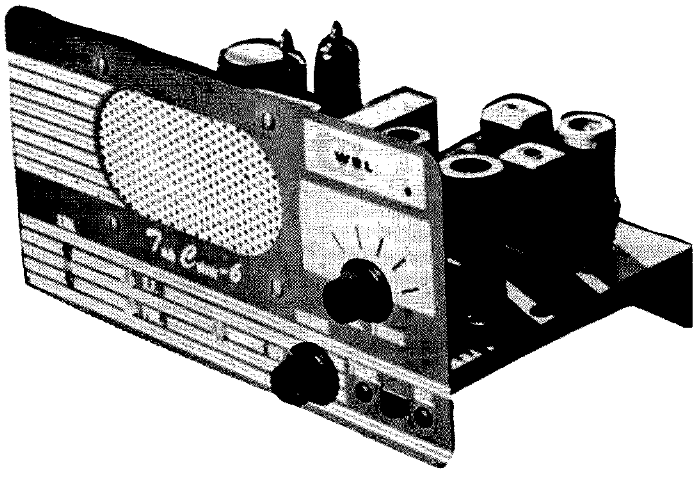


73 Tests The

World Radio Tech-Ceiver-6

SIX METERS IS ONE of the finest mobile bands we have these days, particularly if you aren't planning to spend several hundred dollars in a sideband transceiver. It is virtually impossible to find a section of the country remote enough to be without contacts and the infrequency of band openings assures you of QRM free local contacts most of the time.

Six meter mobile is not only one of the best bands for keeping in touch with the local gang, but if you do any traveling it is the finest for getting to know the bunch when you drive into a new town.

Those of you contemplating six meter mobile operation would do well to take a careful look at the World Radio Labs Tech-Ceiver TC-6A. This transceiver sells for only $39.95 in kit form less power supply and gives a lot for the little money it costs. WRL sells power supply kits to match the rig for $15.95 for the ac unit and $24.95 for the 12 vdc model just in case you don't have something satisfactory kicking around.

The receiver is a superhet, which is remarkable at this price level. Naturally they have gotten it down to basics with one rf stage, an oscillator-mixer stage, a 2.1 mc *if* stage and two audio stages. Diodes are used for second detector and noise limiter. The loud speaker is mounted right in the front panel. The receiver tunes from 49-54 mc, and has a selectivity of 20 kc at the 6 db points, which is ideal for mobile operation since it allows some flexibility in the tuning and is not as apt to bring about expensive car damage while you are attempting to zero a signal into the receiver.

The transmitter, which runs about five watts input and one watt out, utilizes a 6CX8 triode-pentode tube. One great benefit of this transmitter is its use of the inexpensive 8 mc crystals. The oscillator triples the crystal frequency and feeds it into the pentode half of the tube where it is doubled and presented to the antenna (SO-239) connector via a built-in push-to-talk operated transmit-receive relay. The two audio stages used in the receiver are switched over and used as a high gain mike preamplifier and plate modulator.

The whole unit is quite small. As far as we know this is the smallest six meter transceiver on the market, measuring only 5" x 9¼" x 6" and weighing in at 5½ lbs.

The unit provided us for test was assembled and wired in one evening following the almost exasperatingly simple instructions in the 50 page instruction book. Not only were all the parts there, but they all worked! We hooked the rig to a test power supply and fired it into the five element beam up on the chimney and practically had to beat calling stations off with a stick. Even way up here in the remote wilderness of New Hampshire this little old one watt output was attracting attention. All the reports were the same: good signal, good modulation. There was a dismaying lack of difference between the sensitivity of the receiver and the home station converter-communications receiver setup. We did beat it on selectivity, though this didn't make a lot of difference most of the time.

OK, it works in the home shack . . . how will it do in the car? We decided to mount it in the VW station wagon, which presented some problems due to its six voltishness. This took some digging into the junk box. Down deep we came across a Kupfrian transistorized supply which was small enough to fit in one hand and worked from six volts!

The Kupfrian supply was screwed to the bottom of the rig and the rig mounted under

the dash. I suppose there is no use in revealing the little turmoils that plagued us before everything was working smoothly. Much of it was our own fault. For instance the first mounting place looked fine and seemed just right. The only trouble was that you smashed your knuckle on the rig whenever you shifted into first gear. It was a little trouble to mount there and we tried to make do with a handy supply of Band-Aids. As more and more cripples reported back from trips to the post office every day we decided to move the rig.

Then there was the little matter of the high pitched whine in the receiver from the supply. Hmmm, no filter . . . what do you know! We should have solved this one on the workbench instead of under the dash for fellows get to acting funny when they have been upside down for an hour or two and the blood has drained down into the head cavity.

Someone could have warned us about the six meter output of the VW engine too. I think it has more output than the rig. We put Sprague condensers in everything but the gas line and got the noise down to an acceptable level.

First we tested the unit by talking to it from the home station while someone was out for mail or food. This was easy for in a small town like this everything is almost within shouting distance. We then peaked up the rig as best as we could and headed for our little nearby mountain top: Pack Monadnock, just 3.5 miles down the road and 2600 feet high. Up there we ran into QRM. There were stations on all over southern New Hampshire and we could hear them right down through Massachusetts into northern Connecticut. The band was really quite crowded and we had a fine time working one station after another until way after midnight. We've been up there a few times since and the response is always the same: lots of contacts.

Though we really haven't had time, we've kind of looked the Tech-Ceiver over rather carefully to see what we could do in the way of modification. About the only change we would make would be to add a separate oscillator stage in there somewhere and change the present one over to a doubler, allowing us to run straight through in the final. This would be mostly just for something to do for we never have had much trouble as a result of the low power output of the rig . . . but then we've never tried to use it for DX'ing during a band opening.

Taken as it is, this is an excellent low cost, small, portable, six meter transceiver which easily mounts in any car and turns in a creditable performance.

Fast Bandswitching Linear Amplifier

Paul Barton W6JAT

Photos: Ernie Peterson W6NNS

The main "claim to fame" of this amplifier is its ability to switch bands quickly. It can be switched to another band ready to go on the air as quickly as you can turn the knob to the desired band.

This amplifier was built by "Buddy" Alvernaz, W6DMN, who sees with his fingers, to demonstrate Jennings Radio's special kilowatt bandswitching assembly. It is currently being service tested in Buddy's ham shack.

The Jennings Radio RX-274 band switch assembly is housed in a cast aluminum housing, visible against the panel behind the ten-fifteen meter tank coil, in Fig. 1, and the partially completed chassis, Fig. 2. Two Jennings Radio UCSL-500 type vacuum capacitors are mounted on the housing for the input and output capacitors of a PI net. For each band, each vacuum capacitor can be preset to any desired setting with an allen wrench through the

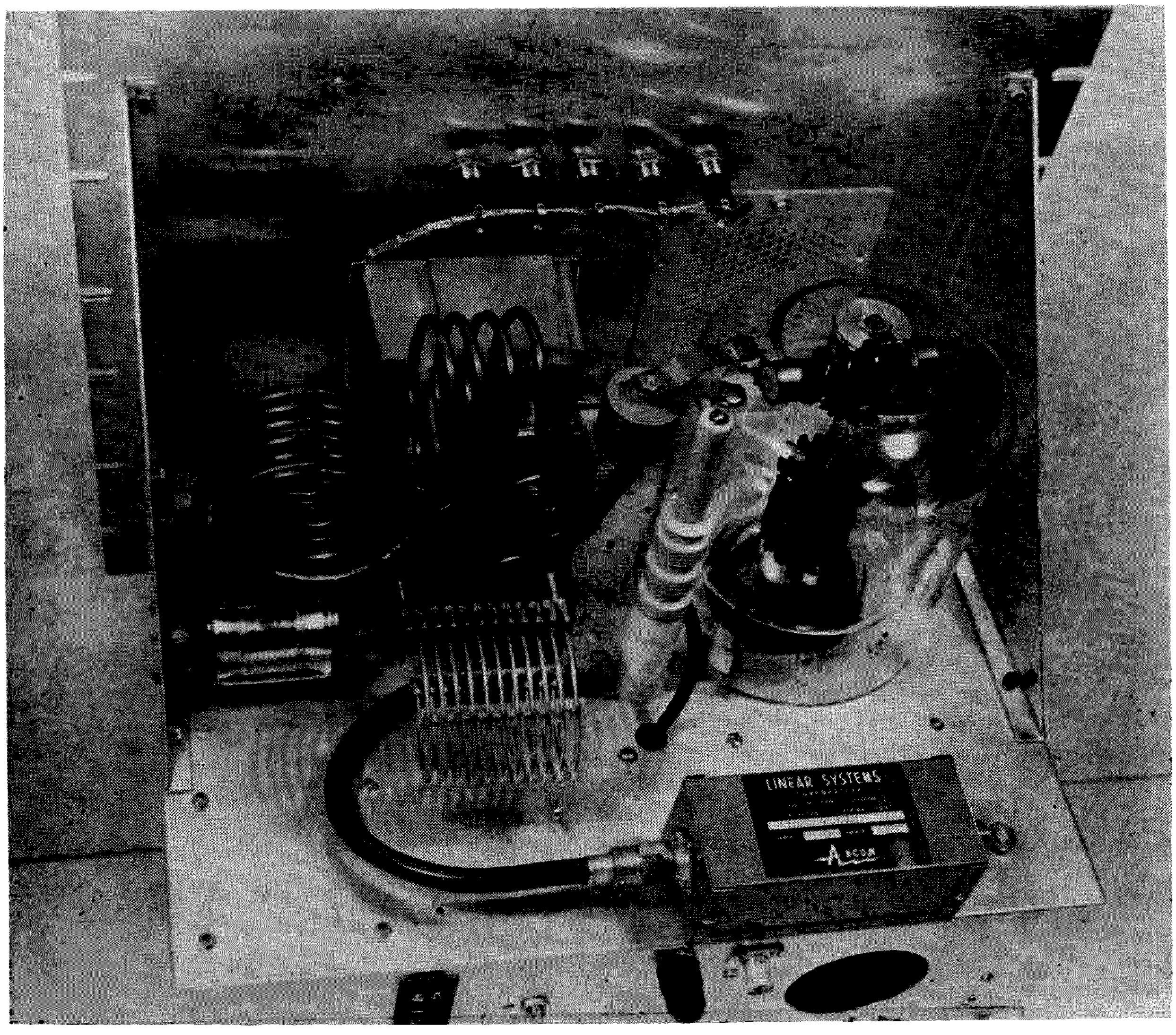
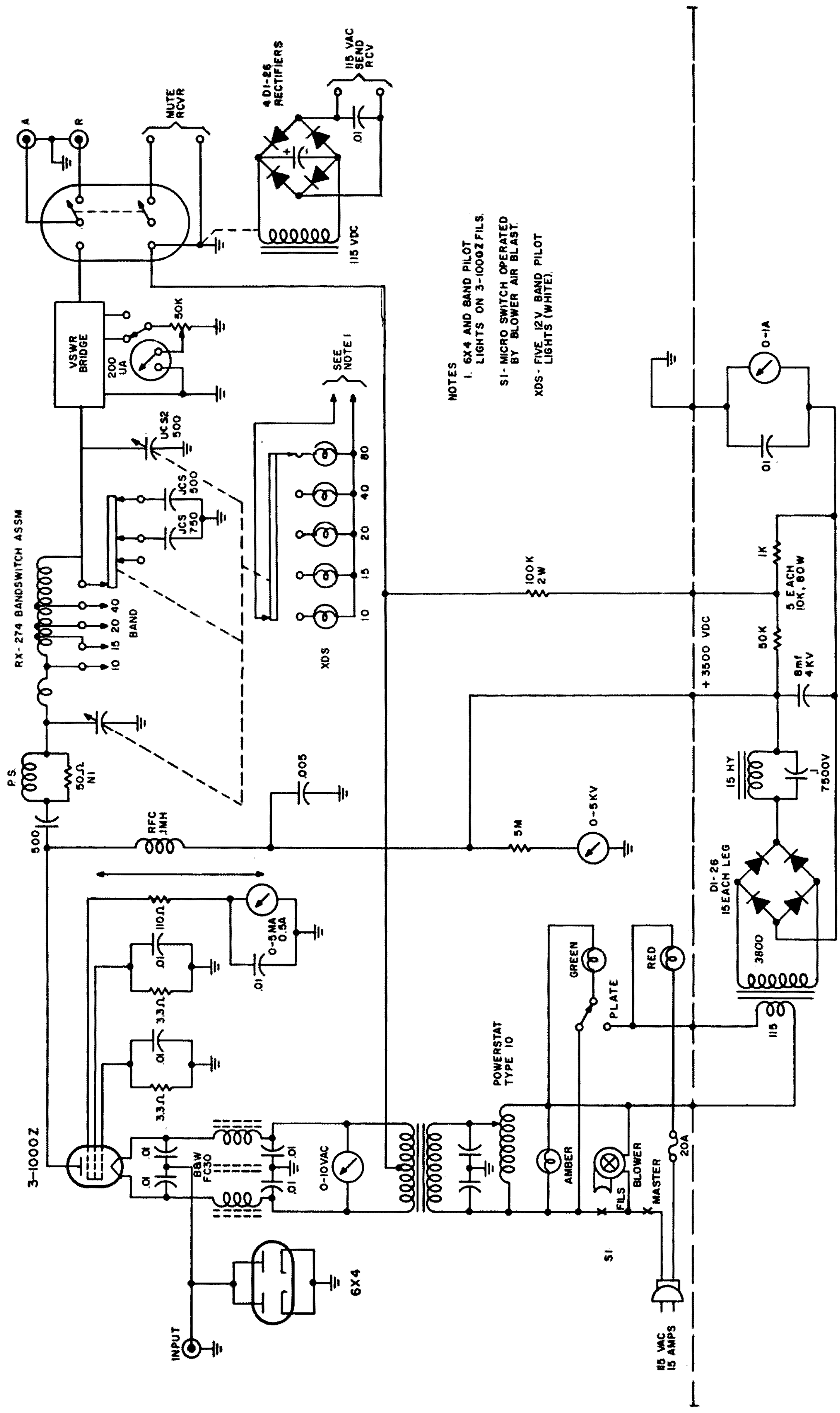


Fig 1. The 3-1000 Z amplifier could be built from this photograph. The band switch assembly is visible against the panel.



A
R
MUTE RCVR
4 DI-26 RECTIFIERS
115 VAC SEND RCV
.01
115 VDC
VSWR BRIDGE
200 UA
50K
SEE NOTE 1
UCS2 500
JCS 500
JCS 750
RX-274 BANDSWITCH ASSM
10 15 20 40
BAND
80 40 20 15 10
XDS
NOTES
1. 6X4 AND BAND PILOT LIGHTS ON 3-1000Z FILS.
S1 - MICRO SWITCH OPERATED BY BLOWER AIR BLAST.
XDS - FIVE 12V BAND PILOT LIGHTS (WHITE).
100K 2W
+3500 VDC
0-1A
.01
1K
5 EACH 10K, 80W
50K
8mf 4KV
15 HY
.1 7500V
DI-26 15 EACH LEG
3800
115
P.S.
50Ω N1
500
RFC 1MH
.005
5M
0-5KV
110Ω
0-5MA 0.5A
.01
33Ω
.01
33Ω
.01
3-1000Z
.01
.01
B&W FC30
.01
.01
0-10VAC
POWERSTAT TYPE 10
GREEN
RED
PLATE
AMBER
BLOWER
FILS
MASTER
20A
S1
6X4
INPUT
115 VAC 15 AMPS

front panel. The allen wrench adjusts a set screw which raises or lowers a cam which determines the setting of the capacitor.

A sliding progressive-shorting tap switch is mounted on the housing to switch the tank coils and to add more output capacity at the lower frequency bands. Vacuum capacitors have been used for this purpose due to their excellent current carrying capabilities.

There is also an auxilliary switch that can be used for bandswitching other stages (probably through relays), or for pilot lights, or what have you.

These two slide switches and the cam actions are ganged and set up for five bands.

Turn to the desired band, initially tune up the amplifier for that band, and thereafter when you turn to that band it will be perfectly pretuned. The re-setability of this arrangement is excellent.

The grounded grid-driven cathode circuit is used for greater simplicity and stability. No neutralization is needed on any band.

A tuned grid (or cathode) circuit is always recommended but has been omitted here for simpler band switching. In its place a 6X4—visible in Fig. 3 has been connected to the cathodes to load the positive half cycle of excitation when the linear amplifier is non-conducting. This keeps the load on the exciter reasonably symmetrical. A SSB-100F drives this amplifier to full output with ample excitation margin.

The B & W FC-30 filament choke (Fig. 3) is a natural for this application, though a homemade choke can be made that works very well. Ten turns of #10 cotton enameled wire wound on a broom handle then the broom handle removed, for each leg of the filament, works fine.

It is important to maintain the filament volt-

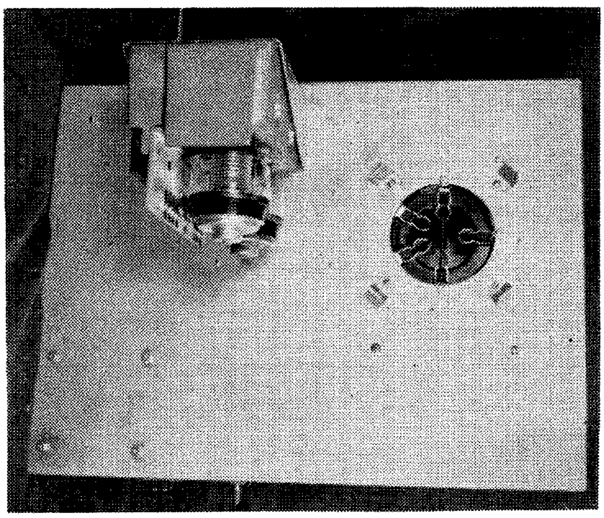


Fig 2. Partially completed chassis showing bandswitch. Close inspection will show the grid bipass from each grid pin to the chassis.

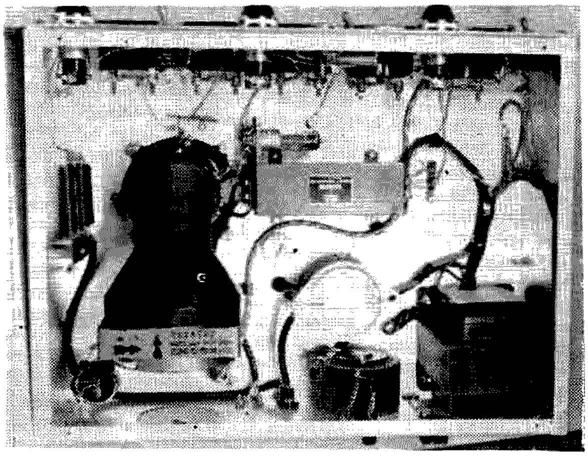


Fig 3. Sub chassis view. All parts were mounted & wired by W6DMN.

age at the proper level, so a Powerstat Type 10 and filament volt meter is installed. (Fig. 3). On initial operation, an accurate laboratory meter should be connected directly across the tube filament *terminals* and the powerstat brought up to 7.5 volts on the accurate meter. Then note the reading of the panel filament meter that is connected across the filament transformer. After that the filaments may be adjusted by reference to the panel meter.

The grid metering circuit was lifted verbatum from a pamphlet by Bill Orr W6SAI, Eimac. It works fine. Each of the three grid terminals are bypassed to ground through a .01 disk capacitor and a 3.3 ohm resistor. As the grids are tied together internally, the three 3.3 ohm resistors are in parallel also. This gives 1.1 ohms of grid leak. A half ampere of grid current across this 1.1 ohm grid leak will give .55 volts. So connect a .55 volt dc voltmeter across the grid leak and call it a half ampere meter. Use any available, low range milliamp meter and put enough resistance in series with it to make a .55 volt meter. For instance if a 5 ma meter is available (which could then be read as a 0-500 ma), 110 ohms in series with the 5 ma meter (assuming negligible meter resistance), would make the 5 ma meter read full scale when .55 volts was impressed. Precision metering at this point is unnecessary, so precision calculations or resistors or meters is also unnecessary. 260 ma of grid current at full load and drive is normal.

The grid terminals are bypassed with a .01 disk cap *above* the chassis, to get as close to the grid as possible. This can be seen by very close inspection of the picture of the incomplete rig showing the tube socket mounted (and bypassed) and the RX274 band switching unit. (Fig. 3)

A 4-1000 A tube works in this linear ampli-

fier with no changes except that the three grid terminals should be tied together at the socket to make the grid metering circuit read properly.

It is important to use a tube socket that puts no strain on the glass seals around the tube pins. The Eimac SK 510 is recommended. The Eimac SK 500 socket, which is the older cast aluminum, air system socket has been reported to put too much strain on the 3-1000Z.

The cooling fan is a PAMOTOR*-Axial Fan Model 1000, made in West Germany and is exceptionally smooth. (Fig. 3) It is rated at 125 CFM. The sheet metal adapter from the blower to the bottom of the tube socket would not work until vanes were installed inside to prevent the air from cavitating. Then the air came through very well.

Pressurizing the chassis is simpler but less efficient. Also, this arrangement soon blows the chassis full of dirt.

The switching arrangement is simple and safe. A line cord comes into the amplifier chassis and goes through a 20 amp fuse and a master toggle switch. This switch carries the line current for the entire rig, including the power supply. When this switch is first thrown, it only turns on the fan. When the fan gets up to speed, it actuates an air micro-switch—actuated from a vane in the air stream. The air micro switch then turns on the filaments. Loss of air turns off the filaments.

The plate switching uses a single pole double throw toggle switch, and takes its power after the air switch. So loss of air will also turn off the plate power. The double throw plate switch energizes a green pilot light in the off

* PAMOTOR, *Inc., 312 Seventh St., San Francisco 3, California*

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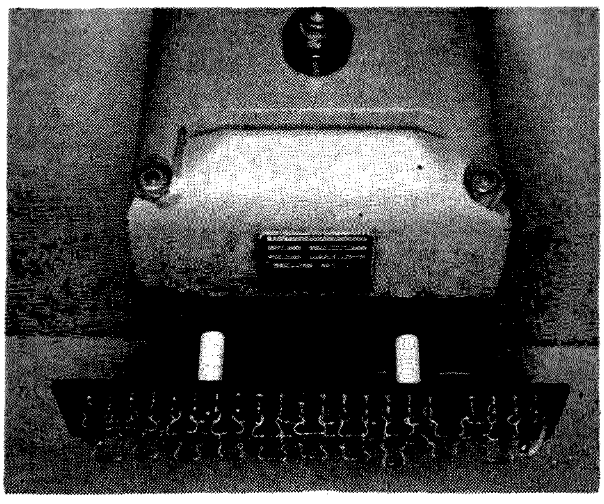
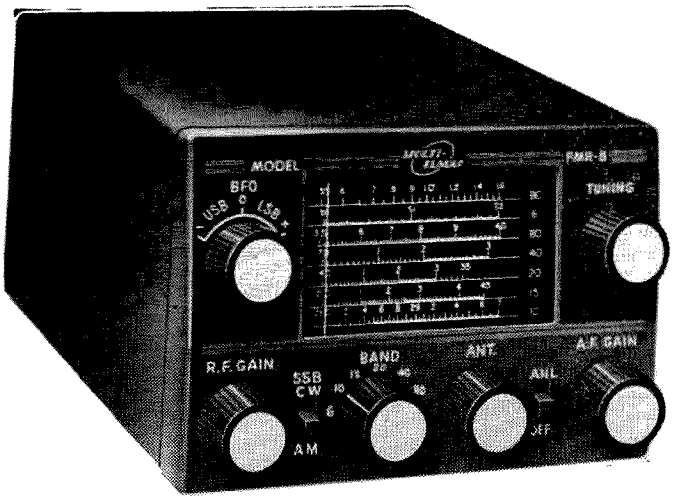


Fig 4. The silicon diode rectifier system is comparable in cost to the thermionic system and saves space, heat and switching.



James L. Weeks, W6FNG
P. O. Box 307
Wrightwood, California

A Review

The PMR-8

THE LAST FEW YEARS have seen several entries into what I will call the compact-receiver market. Notably among these entries were the PMR-series by Multi-Elmac, the KE-93 by Automation Electronics and the G-66 series by Gonset. However, the Multi-Elmac people are still marketing their line now represented by the PMR-8. Vital statistics —4⅝"h, 7"w, 11"d @ 8½ lbs.

There has and I guess always will be a requirement in my ham operations for a receiver that is small enough to put in a suitcase for a trip yet be usable on a field day excursion in the car or can double in the home shack with performance equal to a "big set." And, last but not least, it has to fit my budget of around $200.00. My old KE-93* filled that bill, but in a moment of financial greed, I disposed of it. I still had the need; so I looked around and settled on the PMR-8. I am so pleased with it that I want to pass the good word along.

Band coverage is 80, 40, 20, 15, 10 and 6 plus the broadcast band. Dual conversion is employed. The 1st *if* operates at 2238 kc, the 2nd *if* at 262 kc. Because of physical limitations and for reasons of pure economics, the band-pass width or selectivity of the *if's* is limited to a fixed 3 kc—i.e. the selectivity is 6 db down at ± 3 kc. The bandwidth is a compromise between reasonably good audio quality and selectivity acceptable for average band conditions. Skirt selectivity (or cut-off) is exceptionally good, which compensates in some measure for lack of a more narrow and controllable bandwidth.

After a nominal warm-up period, the drift factor was excellent, even without a regulated B+ supply to the hf oscillator. Mechanical stability is truly outstanding. One can literally drop the receiver from a height of several inches above the table top without even a flutter on the pitch of a CW signal.

I primarily use the set for CW. The avc action on CW is just right. It is fast enough to adequately block the receiver so as to give me a good monitor copy of my own sending without cracked ear drums; yet it (the avc)

does not introduce objectionable lag so as to seriously distort the characters. For mobile CW operation, the bfo is quite good as an auxiliary tuning function for keeping the signal peaked.

The mechanical-electrical layout is such as to permit neat, rigid point-to-point wiring. There are no stray or haywire leads, which is unfortunately a too-often-noted trademark of receivers in this price category. The various switches, condensers, coils, etc. are of top-quality grade. Components are unusually accessible for servicing and circuit tracing, notwithstanding the compact geometry of the receiver.

Operation of the filaments on 12 or 6 volts (ac or dc) can be had by optional strapping of the connections on the Jones-type power plug.

While designed primarily for 250/105* volts plate voltage, I obtained good results by running everything on as low as 90 volts. An external "S" meter can be tied into the same Jones plug. The "S" meter will have to be fabricated by the individual as it is not available as a manufacturer's item. However, sufficient data is contained in the instruction manual for "rolling your own."

The Operating Manual is generally good. Data on alignment could be easily understood and handled by the most rank novice. Circuit diagrams are better than average from the standpoint of readability. There are two full-page drawings showing identification and layout of every major component of hardware both on top and underneath the chassis.

The receiver requires (which I like) an outboard power supply. As I stated earlier, plate voltages are not critical. If you purchase the M-1070 power supply, which is a companion supply for the associated AF-68 transmitter, then you also have a supply for your receiver. But for the receiver alone, you can build a perfectly adequate supply for less than $10.00.

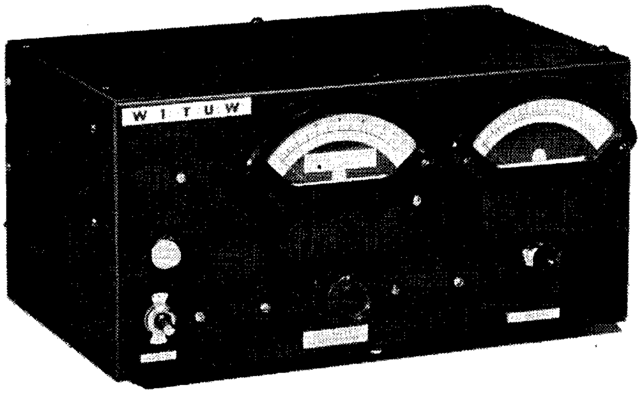
I must point out that performance on 6 meters is surprisingly good for a receiver not designed for VHF operation. If you like 6 meters for general utility, it does a commendable job.

Now, does the set have any deficiencies? Yes, but they are not serious. Ease in SSB tuning could be immeasurably enhanced by replacing the main tuning shaft with a planetary reduction drive-shaft. Such an arrangement would give the receiver really good SSB handling even under mobile operation with one hand on the steering wheel and one hand on the dial knob. The bfo vernier control while handy in SSB tuning does not entirely compensate for a better degree of vernier control

needed on the main tuning knob. I would also replace the output transformer with one having a 500 to 1000 ohms output winding. I use headphones exclusively of the 2000 ohms impedance variety. The receiver develops all sorts of audio, but the bulk of it (the audio) flows to ground through a 6.3 ohms resistor that is connected across the phones and the 3.2 ohms secondary of the output transformer. All of this comes about when you plug your phones in. If you use a speaker or low impedance phones, then there is more than ample audio volume. But me, I like to have the old "cans" rattle loud and clear!

In summation—for the money involved, you get operating features and quality of construction generally found only in receivers costing considerably more. And, if you'll make the two changes I just suggested, I would stack it up against anything up to twice its cost. . . . W6FNG

*June '60 CQ, KE-93 Review, J. L. Weeks.
*165 volts is for the hf/bfo oscillators, screens, etc.



Transistorized Audio Frequency Meter

David Cabaniss W1TUW
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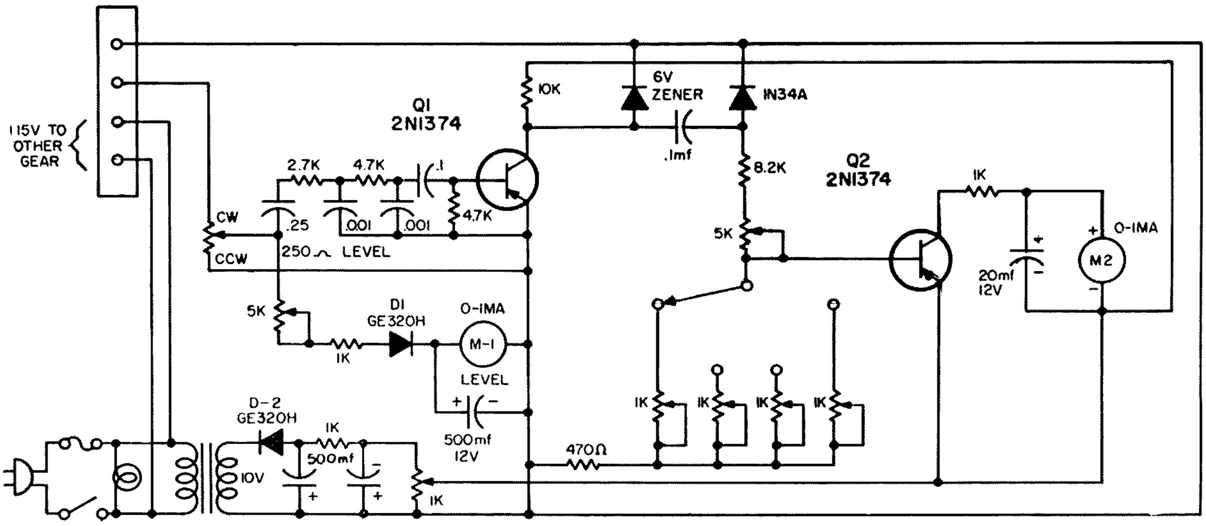
Terryville, Connecticut

Here is a simple piece of gear that will be a worthwhile addition to any amateur's line of test equipment. The various applications of an audio frequency meter are numerous and therefore will not be covered in this write-up. Those interested in constructing a simple and accurate audio frequency meter will find this outline very helpful. The circuit diagram, parts list, and photograph should provide the builder with all of the information necessary to construct a unit similar to that of the author's. Parts layout is absolutely non-critical, and a large quantity of the required components may be found in the well-stocked junk box. Briefly, here is how the circuit operates.

An ac voltage of an unknown frequency is



applied across the 250 ohm input potentiometer (Level Control), and then applied to a filter circuit, which is designed to cut off at about 7000 cps. At the same time, this ac input voltage is rectified by diode D-1, and applied to the Level Indicator meter, M-1. The purpose of the Level Control and Level Meter, M-1, is to insure that the input voltage is at a sufficient level to drive the first transistor amplifier-clipper stage to saturation prior to taking any frequency readings with meter M-2. The 5K ohm potentiometer in series with the ac signal to meter M-1 is set to keep the meter "on scale." In the author's unit, with the 5K ohm level pot at ½ resistance, and the 250 ohm Level Control at the full clockwise position, an input voltage of .2 v ac was required to drive the first transistor amplifier-clipper stage into saturation. The input Level Meter, M-1, at .2 v ac input, read 300 microamperes on the unit shown in the photograph. (This is only a reference reading, which depends upon the setting of the 5K ohm Level Meter potentiometer.) In other words, any reading of 300 microamperes or better will indicate that the input ac voltage is at a sufficient level to take an accurate frequency reading with M-2.

With a sufficient level of ac voltage applied to the filter circuit (on the base of Q1), the filter will pass all frequencies below 7000 cps (approximately) on to the base of Q1. The Zener diode on the collector of Q1 prevents any dc voltage variations in the power supply from effecting the operation of Q1. With a 6 v Zener diode on the collector of Q1, the IK ohm power supply potentiometer should be set so that the potentiometer arm reads about -8 volts dc to ground.

The clipped ac signal is then passed to a pulse counting circuit, consisting of a .1 mfd capacitor, a 1N34A diode, and the "range" potentiometers and resistors connected to the base of Q2, the meter amplifier transistor. The four 1K ohm potentiometers connected to the switch are the range potentiometers, and are set up for 0-50, 0-500, 0-1000, and 0-5000 cps. The 5K ohm potentiometer at the base of Q2 is a coarse adjustment affecting all ranges. Three of the four ranges can be set by WWV, with the tones of 440 and 600 cps. The 0-50 cps range can be set up with an accurate af generator.

Transistor Q2 has the calibrated frequency meter, M-2, in series with its collector circuit. The frequency of the pulses applied to the base of Q2 will be indicated on meter M-2.

The scale for meter M-2 should be made as linear as possible. The scale for meter M-1 is not critical. Only one point on the scale need be marked—the point at which the level of input voltage no longer effects the reading of meter M-2.

The preceding circuit description may give you some ideas of your own. Refinements are always possible. Good luck, and I hope you are as pleased with your new piece of gear as I am with mine!

. . . W1TUW

PARTS LIST

(3) 500 mfd, 12V capacitors
(1) .25 mfd, 200V capacitor
(2) .1 mfd, 200V capacitors
(2) .001 mfd, 200V capacitors
(1) 20 mfd, 12V capacitor
(2) 1K, 1W resistors
(1) 1K, 2W resistor
(1) 8.2KK, ½W resistor
(1) 470 ohm, ½W resistor
(1) 10K, ½W resistor
(1) 2-7K, ½W resistor
(1) 4.7K, ½W resistor
(1) 47K, ½W resistor
(5) 1K, 2W potentiometers
(2) 5K, 2W potentiometers
(1) 250 ohm, 2W potentiometers
(2) GE 320-H diodes
(1) 1N34A diode
(1) 6V Zener diode
(2) 2N1374 transistors
(2) O-1 ma meters
(1) Transformer, 115V pri, 10-12V Secondary
(1) 115V pilot light assembly and bulb
(1) 2A fuse and holder
(1) SPST Toggle Switch, 115V 5A
(1) Line Cord and Plug
(1) Jones, 4-Terminal Strip
(1) Bud Cabinet, 12 x 7 x 6
Assortment of nuts, bolts, grommets, washers, component mounting boards and terminal strips, hookup wire, etc.

Tale of a Dark Night

Walter Mull W3MFA

IT was indeed a wild night. Such a night as was made to order for the commission of foul deeds. Ragged, low hanging clouds, urged on by a moaning wind alternately hid and revealed a moon that, discouraged by the night, was already setting. In the distance, a dog feeling the eeriness of the night, howled forlornly. The few people hardy or foolhardy, enough to be out on such a night hurried along bent against the wind. High on the hill that rose just outside the village a single light glittered from the window of the lonely old house. The house where local legend maintained, murder had once been committed. It was to learn more about this legendary house and its solitary occupant that had brought me

to the village.

No one really knew the strange, dark man who lived in the tottering ruin. He rarely showed himself by day. Except for the aura of evil that seemed to surround him he might have been an object of pity. On his infrequent appearances he engaged in conversation with no one nor bothered to answer those who spoke to him. Always the single light shone from the barren window until far into the night.

I pondered these things in my mind as I stood now at the foot of the weed choked path that wound from the road toward the drooping porch. I hardly knew what real reasons brought me to this lonely place. Ever since I had first heard of the oddly unorthodox man I had been driven by an almost un-natural urge to find out more about him. There was a rustling sound in the weeds behind me. I whirled about in time to glimpse a frightened rabbit dash for deeper cover. Slowly the feeling of stark terror faded and my pounding pulse returned to near normal. I began to ascend the path toward the dark, forbidding bulk of the house. At last I stood just below the porch.

As I cautiously stepped on each of the half dozen sagging treads of the steps it seemed that each one creaked more loudly than the other. Fortunately the banging of a shutter that swung back and forth in the wind masked the sound.

I stood, now, on the porch. Although the night was cold, my palms were wet. I was conscious of the brassy taste of fear in my mouth. The lone lighted window looked out upon the porch but the dozen or so feet to it from where I stood seemed as many miles. I began to ease slowly across to where I could see into the room being extremely careful not to make any noise that might give away my presence to the man in the house. Suddenly I was frozen in my tracks by a shout of wild, demoniac laughter. My, by now completely disorganized, mind conjured up visions of unspeakable violence. Of bodies being hacked to pieces by some deranged fiend.

I don't know how long I stood there poised for retreat yet drawn by a sense of macabre curiosity. At last, screwing my courage up, I resumed my slow progress toward the window. One more step and my view into the room would be unobstructed. Now——!

Dante, with all his imaginative powers, could not have painted with words such a scene of wild disorder. The room was barren of furnishings except for two tables and two chairs. It was evident that the man lived al-

ways on the edge of starvation. On the one table that stood across the room was a loaf of dried up bread, an opened can of some sort of concoction and a bottle partly filled with an amber colored liquid. On the table at which the cavernous figure of the man sat was a typewriter and a strange looking black box from which dangled a profusion of wires. Beside the typewriter was a pile of what seemed to be manuscripts each with an editor's rejection slip pinned to it. Scattered about the room in complete disorder were what must have been dozens of black boxes much like the one on the table.

As I stared transfixed, the man rose from the table. Grasping one of the boxes he began to attack it with a pair of diagonal pliers, pulling wires, tubes, resistors and capacitors from it. Again came that peal of wild laughter.

When the box had been reduced to junk the man's rage seemed to abate. He seated himself at the typewriter and began to laboriously peck out a few lines of print. I inched closer to the window. I could almost make out the words on the paper. Closer, yet closer. Only now was the mystery cleared up. The first sentence was ——To convert the BC 999 transmitter to an all band double conversion receiver, first remove all wiring and components except the fuse holder in the upper left hand corner.

. . . W3MFA

SSB or AM

at the turn of a switch

Edgar Wagner G3BID
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I HAD BEEN working AM for many years and had made many delightful friendships and contacts throughout the world.

Then something happened.

Some of my regular contacts I never heard any more. Various of my friends went on to SSB and I missed the pleasure of my frequent QSOs.

The world seemed to be divided into two. Those on SSB who seemed reluctant to work those on AM and those on AM, like myself, who experienced some difficulty in resolving the SSB. It seemed as though I was faced with a choice of abandoning many of my old friends and going on SSB, or losing many of my old friends when they went on SSB.

I felt there must be a solution to this problem. After all, when the Novice goes on phone he doesn't throw away his key, or abandon his CW facilities. Why was it that those who had gone on SSB seemed to have lost the ability to communicate on AM?

The problem worried me.

I scanned the advertisements to find a receiver that would receive AM, SSB and CW equally well. This I found and as my old receiver was not too good on SSB, I bought a new receiver and found that I could receive all three modes very well.

I then searched the advertisements for a transmitter that would operate on SSB, AM or CW, but here I ran into trouble. There did not seem to be one. Those which were designed to transmit SSB would admittedly put out some sort of an AM signal but the final was always linear, the efficiency for AM was low, and the power also low in many cases. The AM was merely SSB with a carrier inserted, so I tried to design a transmitter where the final could be switched from linear to class "C" with plate and screen modulation.

I was sure it could be done but it was too difficult for me. The change in the operating conditions of the final were too great to make this an easily switchable proposition.

Yet, I did not want to lose my friends on

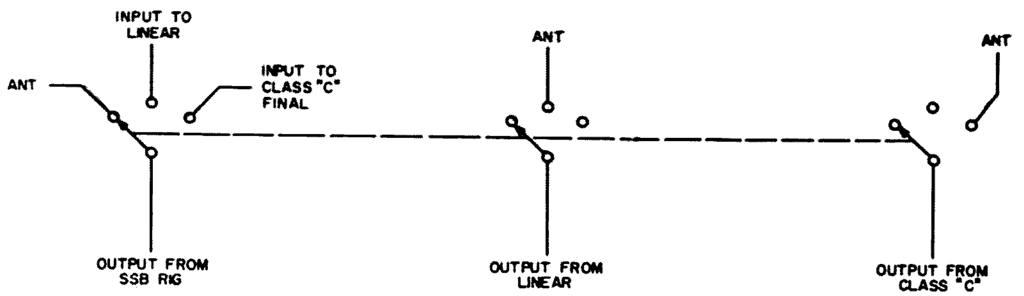

FIG. 1

AM if I went to sideband.

The problem remained, but then I remembered that I had a perfectly good AM rig. I could, of course, keep the AM rig and get a sideband rig as well, but this was clumsy. It took up a lot of space, and it meant keeping two rigs warmed up all the time, and even then it would have meant zero-ing and 2 VFO's every time if I was to make a quick switch from one to the other.

It was at this stage that I realized that I had nearly found my solution. Every SSB rig which I have seen has CW facilities. Why not switch the SSB rig to CW and use that as an exciter to drive the old class "C" final plate and screen modulated?

Here was my solution and as I imagine that most of the other people who are going sideband have got an AM rig, I thought they might be interested to do the same.

All that is necessary is to arrange a switch so the output from the sideband rig can be switched either directly into the antenna or, when operating it as a CW exciter, into the input of the class "C" final, and, if you like, a further position of the switch could feed the output of the sideband rig into the linear final.

Thus, with one switch one could have the choice of a low power SSB rig, a high power SSB rig using the linear, or full-blooded plate and screened modulated AM, using the old class "C" final and its modulator.

All that remains is to ensure that the SSB rig does not overdrive the class "C" final as it will probably have far more output than is needed to drive the final.

This can be done either by loading the Pi output of the SSB rig very lightly or, in most rigs, by reducing the carrier insertion to an appropriately low level.

In my own case I am using a KW Viceroy. This can be switched so that I can either use the Viceroy barefoot straight into the antenna, or to drive the KW 500 linear final, or to drive the old class "C" final, plate and screen modulated. The switching is done as shown in Fig. 1 —of course a high insulation ceramics switch must be used which must have low loss contacts.

It is a complete joy to be able to tune over the band and go back to any station, be they operating SSB, AM, or CW, by merely the turn of a switch and not to have that horribly frustrated feeling when you hear a station on AM whom you are very anxious to work but who for one reason or another, possibly because his receiver is not capable of it, has difficulty in receiving sideband.

. . . G3BID

Transistorized Dynamic Mike Adaptor

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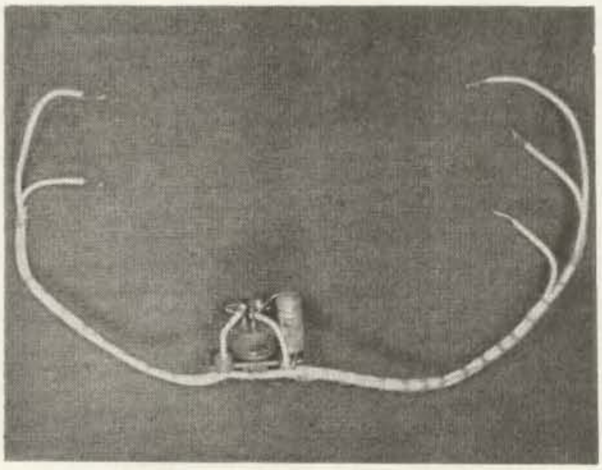
316 Stratford Avenue
Fairfax, Virginia

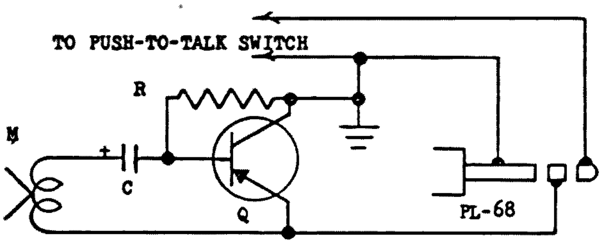
Photograph by: Morgan S. Gassman, Jr.

SURPLUS military transmitters were almost always designed for use with carbon microphones. These units have the advantages of rugged reliability, low impedance and high output with reasonable intelligibility. However, for many amateurs, reasonable intelligibility is not good enough and the choice of a dynamic or crystal microphone is made for surplus conversions. In this case, the usual course of action is to rip out the existing audio input circuitry and install a vacuum tube speech amplifier.



The little device shown in the photographs is a much simpler answer to the problem and requires a lot less work. The output of a low impedance (50 ohm) dynamic microphone drives a single stage transistor amplifier which plugs into and is supplied power by a standard, positive battery, carbon microphone circuit. The assembly is small enough to fit inside of many microphones, may be installed in the mike stand base or may be housed in a small metal case inserted in the mike cable. While the unit may be installed in the equipment, this would require replacement of the mike jack since both leads of the microphone coil must be above ground.

The diagram shows the simplicity of the amplifier-adaptor. High gain with low noise is achieved by operating a power type transistor



C.....50 MFD, 15 WVDC ELECTROLYTIC CAPACITOR
M.....LOW IMPEDANCE DYNAMIC MICROPHONE
Q.....PNP POWER TRANSISTOR (SEE TEXT)
R.....1/2 WATT COMPOSITION RESISTOR (SEE TEXT)

at low collector current. The characteristic low input and output impedances of the power type transistor are retained in this class of operation, making the circuit ideal for the task at hand. Those interested in pursuing the subject further are referred to the short article, "Low Impedance Transistor Preamp," by W. F. Jordan, which appeared on page 78 of the March 28, 1958 issue of ELECTRONICS.

Almost any power transistor may be used in this circuit. Install the transistor of your choice and clip in a 25,000 ohm variable resistor in lieu of "R". Connect the microphone, plug into the transmitter mike jack and adjust "R" for maximum gain consistent with low distortion and noise. Measure this resistance and install the nearest stock value ½ watt resistor. This value will probably be in the vicinity of 10,000 ohms.

Performance of the unit is remarkably good. Tests were conducted using a Turner Model 999 50 ohm dynamic mike. The circuit was terminated in the microphone input of an AN/ARC-2 Transmitter-Receiver which is considered more or less typical of surplus equipment. Numerous types of 1 ampere and up, PNP power transistors were tested with consistently good results. The 2N538 transistor shown in the photograph was used because it was the smallest power type transistor on hand. This unit gives substantially higher output than the old reliable T-17 microphone.

There are other applications of this circuit which have not been explored. A negative battery microphone circuit, though virtually unknown in surplus equipment, would permit the transistor stage to be reversed, placing the emitter at ground potential. This would ground one side of the microphone coil, reducing hum and noise pickup. The same result could be obtained with the circuit shown if an NPN transistor were used. While scarce in the power types, these units are available. One further possibility lies in the use of this circuit with vacuum tube input amplifiers which place the carbon mike in the cathode circuit of a triode.

As pointed out, this circuit is ideal for use with surplus equipment since no changes are required in the audio input stages. Also, the simplicity and low cost of this device make it very attractive for other applications.

. . . W4WKM

A Practical Six Band Ground Plane

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The antenna described in the following article is unique in the fact that it operates with an SWR of under 2:1 on all amateur bands between 7 and 144 mc. The basic principles of the multi-band ground plane antenna are not new, but it is felt that the extended frequency coverage (20 to 1 ratio) offered by this simple antenna will prove of interest to other amateurs faced with space limitations while desiring "all band" operation.

Basically the antenna consists of a full sized wire element ground plane on the lowest frequency to be used, in this case 7 mc. To this 7 mc antenna have been added separate resonant radiating sections and radials for each successively higher frequency band. The entire antenna is then fed at a common point with a 52-ohm coaxial transmission line (either RG-8/U or RG-58/U).

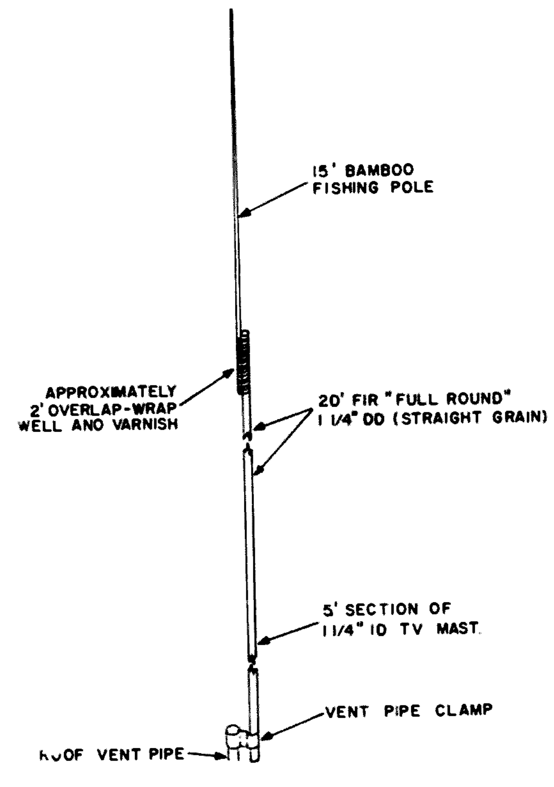


FIG. 1 MAST CONSTRUCTION

A series of tests have been conducted over an extended period at W6WAW in which operation of the ground plane was compared with a multi-band doublet antenna approximately 45 feet above ground. On the 7 mc band reports from the East Coast began to show the ground plane's advantage from the lowered angle of radiation achieved, while reports from Africa, Asia and South America have shown a consistent 12 db (two "S" units) increase in signal strength over those obtained on the doublet.

On VHF (50 and 144 mc), comparison of the multi-band ground plane's operation with two conventional single band ground plane antennas at similar height have produced exactly the same reports at distances up to 150 miles, thus the advantage to the casual VHF operator is simply one of having a single antenna for "all band" operation.

One note of caution should be observed however; as in any multi-band antenna system radiation of harmonics becomes a serious problem, thus the use of an antenna coupler between output of the transmitter and the feed line is mandatory in most cases on the lower frequencies. For VHF operation this has not proven to be a problem however, and only the normal lowpass filter has been required at output of the transmitter.

Construction and erection of the antenna will take approximately 4 hours, and can normally be completed without assistance unless you are mounting it on the roof, where a second set of hands are invaluable.

First, perform an inspection tour of the roof as this is the best spot for installation, although the antenna should work equally well at ground level provided the surrounding area is reasonably clear of obstructions. Look for a vent pipe, or similar spot for attachment of the base section. This is not critical in regards to load strength, as very little actual weight is applied to the mounting. The vent pipe (or similar support) should be approximately centered on the roof for ease in running the three sets of radials. The mast (Fig. 1) consists of three sections. The bottom section is a 5-foot length of 1¼-inch ID galvanized TV mast. The center section is a 20-foot length of 1¼-inch fir "full-round" closet pole, while the top section is a 15-foot bamboo fishing pole.

Securely lash the fishing pole to one end of the "full-round," allowing approximately 30 inches overlap. Wire may be used for this, or heavyduty fish-line, however if the latter is

used it would be wise to coat the joint heavily with spar varnish. In turn, insert the other end of the "full-round" into the flared end of the TV mast section. Now screw in three eye-bolts, 120 degrees apart, at the junction of the fishing pole and the "full-round" for the top guys (Fig. 2). A second set of three eye-bolts should also be positioned 120 degrees apart approximately at the mid-point of the "full-round."

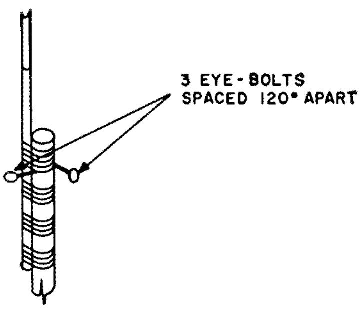
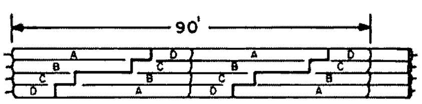


FIG. 2 TOP DETAIL



A = 35'
B = 32'
C = 13'
D = 10'

FIG 3 CUTTING DETAIL

The radiating sections, plus three sets of radials are cut from a single 100-foot section of 4-wire TV rotator cable (Fig. 3). Exact length of these sections will be dependent upon what portion of the bands you wish to operate in, however they may be easily computed from the standard ground plane formula; length = 234/f (mc) for the radiating section, and; length = 240/f (mc) for the radials. Typical element lengths are given in Table 1 for the prototype antenna constructed, and these should suffice in most cases. The completed antenna exhibits an SWR of less than 2:1 over 200 kcs at 7 mc, and less than 1.5:1 over 300 kcs at 14 mc. On all higher frequencies you can cut for the center of the band and still be under 1.5:1 over the entire band.

Attach a stand-off insulator to the "full-round" at the junction with the TV mast section, and place a water-pipe ground clamp directly below the insulator, screwing down tightly until it bites the support.

After cutting the 4-wires of the radiating

TABLE 1

Element	7 mc	14 mc	21 mc	28 mc	50 mc	144 mc
Vertical	32' 6"	16' 6"	11' 0"	8' 2"	54"	18"
Horizontal	32' 8"	16' 8"	11' 2"	8' 4"	56"	19"

section for 7, 14, 21 and 28 mc, as shown in Fig. 3, strip back the insulation at the common end and twist all 4 wires together. Install a lug at this point and solder. Tape each spot where a particular radiating section ends and attach the lug to the stand-off insulator.

Now cut the three sets of radials from the remainder of the rotator cable and prepare the same way as the radiating section. These are identical to the radiating section, except being slightly longer. The 50 and 144 mc radiating sections and radials are then made from 2-wire scrap left over. Fasten a strain insulator to the end of each 7 mc radial and attach a sufficient length of clothesline guy to permit the radials to be tied off.

Attach the 50 and 144 mc radiating section to the stand-off insulator in the same manner as that for the lower frequencies, and tape both radiating sections to the "full-round" approximately 8 inches above the insulator. Stretch the complete radiating section along the mast and tape securely every 36 inches. If the radiating section is longer than the mast, spiral wind the tape until it fits. This should not affect operating unless you wind the turns too close together.

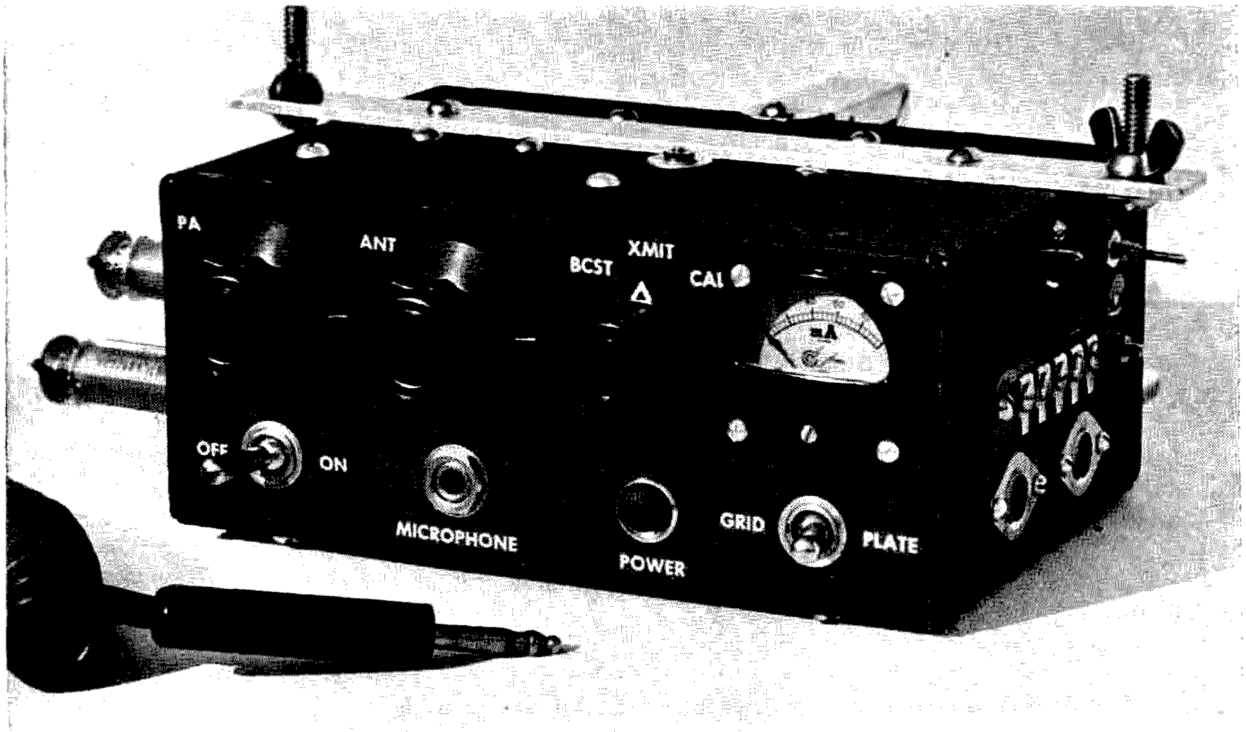
Attach the two sets of guys (clothesline works fine) and secure a vent pipe clamp to the bottom of the TV mast section. Now comes the job; *Don't* try this alone if the wind is blowing . . . Roughly tie down the top guys and walk the mast upright, slipping the clamp over the vent pipe. It should hold fairly steady while you secure the remaining guys. Once this is completed the worst is over.

Attach all three sets of radials to the water pipe ground clamp on the TV mast section and run them out approximately 120 degrees apart. The radials should slope if possible but this is not absolutely necessary. Tape the 50 and 144 mc radials to the lower frequency radials and erection of the antenna is complete.

Solder a lug to the inner conductor of the coaxial feed line and attach to the radiating section at the stand-off insulator. Similarly, solder a lug to the shield braid and attach to the water pipe groupn clamp. Length of the feed line between the transmitter and antenna is not critical, however in some cases the SWR may be lowered by a bit of "pruning."

Total cost of the complete antenna (exclusive of the coaxial transmission line) should run a bit under ten dollars, and that figures out to slightly over a "buck and a half a band."

. . . W6WAW



75 Meter Mobile Transverter

Bruce Goewey WA6FPG
1931 S.E. Rainbow Drive
Santa Ana, California

Do you have a hankering for a really compact mobile rig? If so, and if you can get along with single-band AM operation, the 10-watt transverter described in this article may be exactly what you've been looking for. It offers ample power for most contacts, husky modulation, reception that is both sensitive and selective, and full push-to-talk operating convenience. Yet its cabinet measures only 3" high, 5" deep and 7" wide. This size is made feasible by external mounting of tubes, crystals and modulation transformer.

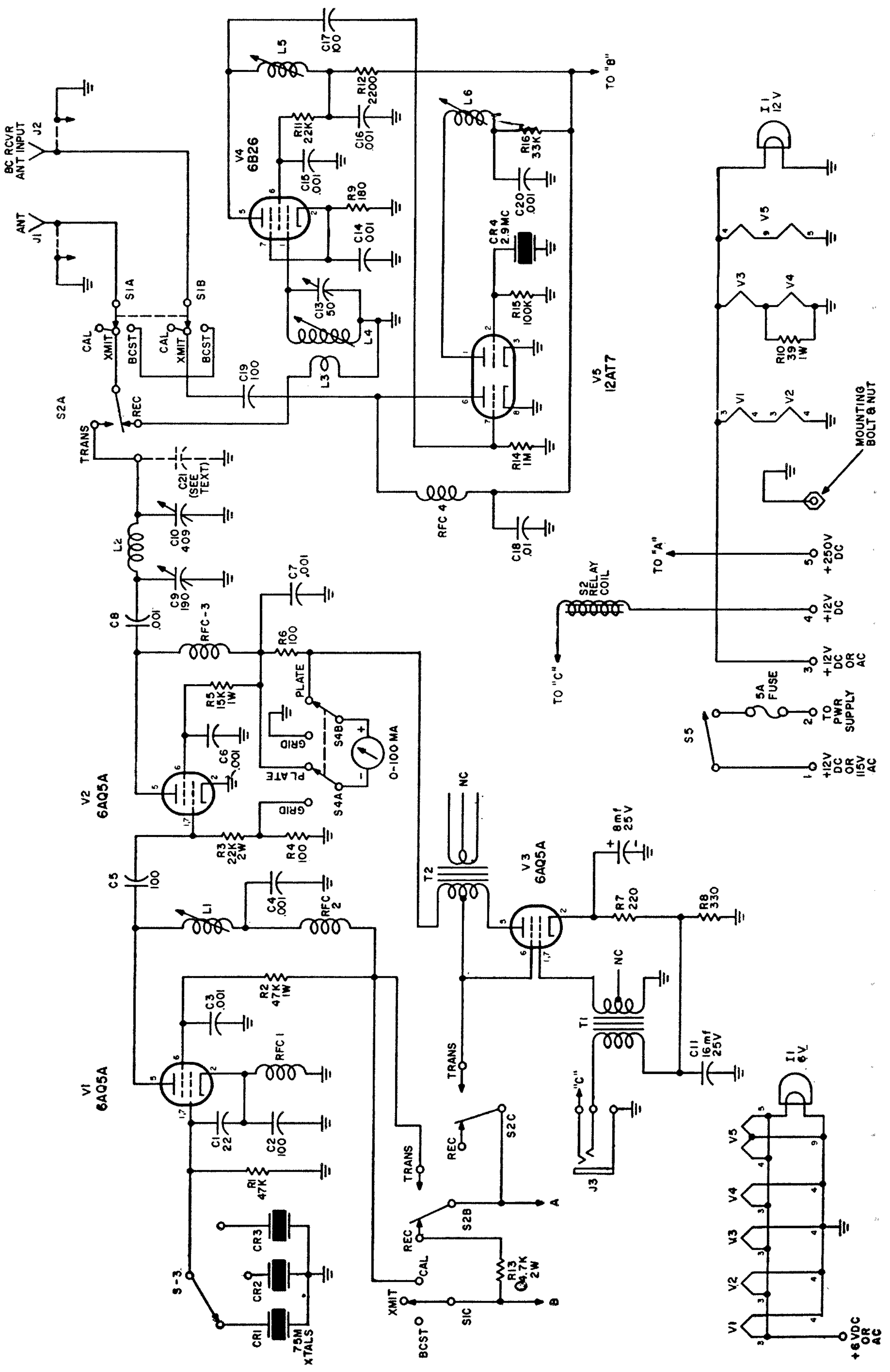
The transverter illustrated and described was designed for the 75 meter phone band because this band, in the opinion of the author, is the best for all-round mobile operations in the southern California area. With appropriate inductance modifications, however, the transverter should be equally effective on 40, 20, 15 or 10 meters.

Design features of the transverter are calculated to simplify "under way" operating procedures. Push-to-talk relay switching of B+ and antenna circuits provides basic operating convenience. Multiple crystal switching permits quick transmitter frequency selection. A front panel switch permits instant selection of either broadcast band reception or transverter operation in conjunction with a companion automobile radio. It also provides a "calibrate" position for spot tuning the transmitter frequency on the automobile radio.

Externally-adjustable slug-tuned coils in the transmitter and converter circuits permit peaking of tuned circuits after automobile installation. An externally-accessible fuse protects the entire transverter circuit and permits disabling the circuit to discourage tampering if your car must be left unlocked in a parking lot.

Power Supply

Power supply requirements are very modest. The described transverter is being fully powered by a Heathkit GP-11 mobile vibrator power supply that is tapped into the 12 volt electrical system of a Fiat 600. This power supply draws 3 amperes at its full rated output of 250 volts and 100 ma, which happens to


BC RCVR ANT INPUT
J2
ANT
J1
S1A
S1B
CAL
XMIT
BCST
REC
TRANS
S2A
V4
6B26
L5
C17 100
R12 2200
TO "B"
R11 22K
C16 .001
C15 .001
R9 180
C14 .001
C13 50
L4
L3
C19 100
L6
R16 33K
C20 .001
CR4 2.9 MC
R15 100K
V5
12AT7
R14 1M
RFC 4
C18 .01
C21 (SEE TEXT)
C10 409
L2
C9 190
C8 .001
RFC-3
R6 100
C7 .001
R5 15K 1W
C6 .001
PLATE
GRID
S4B
S4A
0-100 MA
V2
6AQ5A
R3 22K 2W
R4 100
C5 100
L1
C4 .001
RFC 2
T2
NC
V3
6AQ5A
8 mf 25V
R7 220
R8 330
T1
C11 16 mf 25V
V1
6AQ5A
R2 47K 1W
C3 .001
RFC 1
C1 22
C2 100
R1 47K
S-3
CR1
CR2
CR3
7.5M XTALS
S2B
S2C
S1C
R13 4.7K 2W
J3
"C"
A
B
I1 12V
R10 39 1W
MOUNTING BOLT & NUT
TO "A"
+250V DC
S2 RELAY COIL
TO "C"
+12V DC
+12V DC OR AC
5A FUSE
S5
TO PWR SUPPLY
+12V DC OR 115V AC
I1 6V
+6 VDC OR AC

perfectly match the B+ requirements of the transmitter section. The converter section draws only 20 ma.

Measuring only 4⅜" high, 4⅛" deep and 6½" wide, the GP-11 will be found as easy to mount in your automobile as the transverter.

The power circuit of the transverter is arranged so that it may be connected to operate from either an ac or dc supply. The circuit diagram shows proper connections for the one or the other.

It will be noted that 12 volts of dc must be available for operation of the push-to-talk relay when an ac supply is used. For initial tune-up, testing and operating, the author powered the transverter directly from a Gonset G-76 ac supply, which has a 12 volt dc output for relay operation in addition to 12 volts of ac for filament power.

If 12 volt dc is not available from your ac power supply, batteries will suffice for limited operations. The current drain of the relay is approximately 120 ma.

Alternatively, manual closing of the relay contacts, while bothersome, will at least permit transmitter tune-up and testing. There is no problem with converter tune-up in this regard, of course, since the relay coil draws no power in the receive mode.

For 6 volt operation, tube filaments are wired as shown in the 6 volt filament section of the circuit diagram. Also, the relay must have a 6 volt coil; or, alternatively, a 62 ohm 1 watt dropping resistor in series with a 12 volt coil.

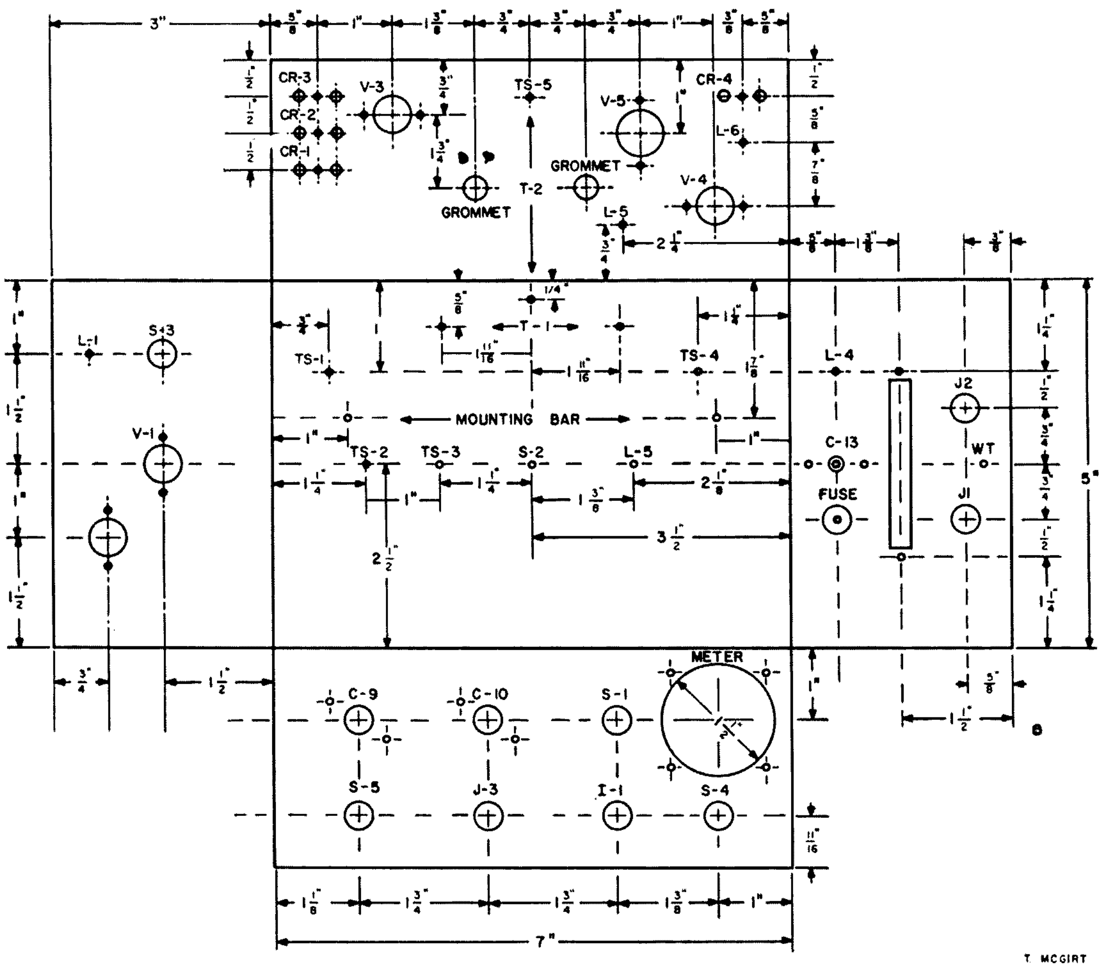
Otherwise, the power circuit of the transverter is the same for 6 volt operation as for 12.

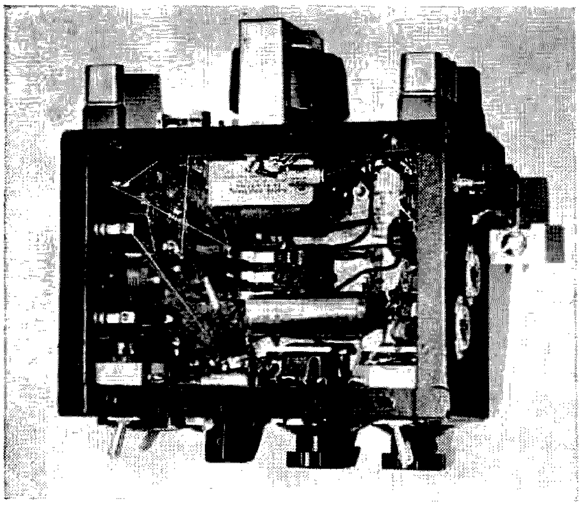
Instructions for wiring the Heathkit GP-11 mobile vibrator power supply for 6 volt operation are contained in the construction manual supplied with that unit.

Transmitter Section

The transmitter section circuit is conventional. A 6AQ5A oscillator (V-1) provides about 4 ma of grid drive to the 6AQ5A power amplifier (V-2) under full load. With a full load, the combined plate and screen current of V-2 will be shown by the front panel meter to be approximately 50 ma. If a resonant dip is not obtainable during loading, extra capacitance at C-21 should be added.

With short rf leads, wiring of the transmitter section is not critical. Self-oscillation of the final





may occur, however, if the cathode of V-2 is not tied to chassis ground as directly as possible. A ground lug under the nearest socket retaining nut can be positioned so as to permit the socket cathode lug to be bent down and soldered almost directly to chassis ground. Also, grid and plate leads of V-2 should be kept separated as much as possible.

L-1 (as well as L-3, L-4, L-5 and L-6 in the converter section) were wound on slug-tuned forms, using the cut-and-try method in conjunction with a grid dip meter. If a grid dip meter is not available, manufactured coils such as those designated in the parts list will ensure required resonances.

Modulator

High level plate and screen modulation is achieved through use of a 6AQ5A (V-3) that is biased for Class A operation and driven by a push-to-talk high output carbon microphone. Voltage developed across R-8 provides the dc power required by the microphone.

Use of a carbon microphone eliminates the need for space- and power-consuming pre-amplifier and modulator driving stages. Also, a good quality carbon microphone provides excellent voice frequency "punch" that is optimum for cutting through QRM and QRN during mobile operations.

Converter Section

The converter section is also conventional. The oscillator is crystal controlled at 2.9 mc. Mixing with incoming signals between 3.8 mc and 4.0 mc, this oscillator frequency spreads the 75 meter phone band between 900 kc and 1100 kc on an automobile radio, which functions as a tunable *if* amplifier for the converter output.

Wiring of the converter section is not critical, but, as in the case of the transmitter section, all leads carrying rf should be kept short. Use VHF wiring techniques and you'll not go wrong.

As with any converter, if a local broadcast station with considerable power is located between 900 and 1100 kc, some degree of feed-through of its signal at its normal position on the broadcast receiver dial may be experienced while the converter section is operating. A simple wave trap mounted between and below the antenna input and output jacks (as shown by "WT" on the layout diagram) will be effective to suppress the interference.

Use a North Hills 64 to 105 uh slug-tuned coil (No. 120-G), or equivalent, with a 270 mmfd mica capacitor parallel-connected at the lug end of the coil. Wire the trap in series with the lead running from S-2A to L-3. Tune by adjusting the coil slug until the offending broadcast feed-through signal is nulled.

The maximum null point is very sharp, so it is best to visually adjust for it while feeding the output of the converter section into an S-meter equipped receiver that will tune the broadcast band.

Construction of the transverter is simplified by the external mounting of tubes, crystals and modulation transformer. This arrangement permits a "straight-line" circuit layout for almost all rf components, and ensures low ambient temperatures, and thus long life, for all cabinet-enclosed components.

A standard 3" by 5" by 7" aluminum chassis with bottom plate is used for the cabinet. Holes can be drilled, punched, filed to size, or "nibbled," depending on the metal working tools you have on hand.

The physical layout diagram shows the location of all mounted parts. Retaining screw holes for which dimensions are not given can best be located by using the component to be mounted as a template (tube sockets, meter, etc.).

After all holes in the illustrated converter were finished, the cabinet was given two spray coats of charcoal gray wrinkle finish varnish (about 20 minutes between coats). The cabinet was then placed in a kitchen oven. The baking heat was turned on full and the oven door was left in the ajar position to permit observation. After some 8 to 10 minutes, the varnish wrinkled. A minute or so later, the cabinet was removed and allowed to cool. The cabinet was safe to handle (carefully) at this point, but no furthre work was done on it for several hours to ensure that the wrinkle finish had dried to a point of maximum hardness.

Decals on the front panel were positioned after all chassis-mounted components were in

place. Despite the wrinkle finish, decals adhere satisfactorily.

Tube sockets should be mounted so that pins 1 and 7 (1 and 9 in the case of V-5) face in the direction of the arrows shown on the layout diagram socket holes. Ground lugs should be mounted under socket retaining nuts as needed—that is, wherever placement will permit the shortest possible ground connections for associated components.

Five terminal strips are used to facilitate placement of certain components. Mounting holes for these are indicated on the layout diagram by "TS-1," "TS-2," etc. The terminal strips are used as follows:

TS-1 (two lugs, one grounded): mounts R-8 and C-11; ties associated leads.

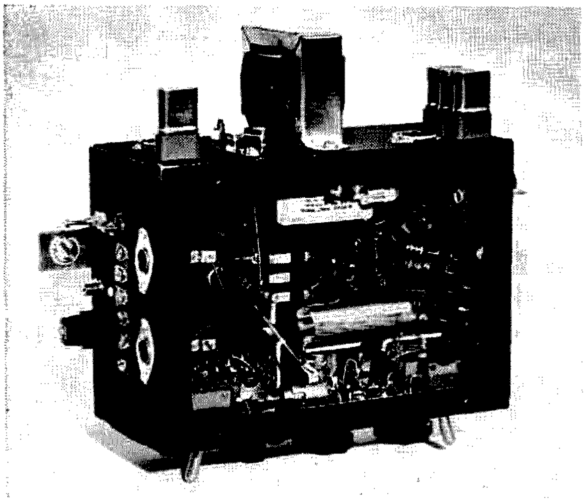
TS-2 (four lugs, one grounded): mounts R-6 and C-7; ties RFC-1, RFC-2, RFC-3, R-2, R-5 and associated leads.

TS-3 (two lugs, one grounded): mounts R-4; ties R-3 and associated lead to S-6A.

TS-4 (two lugs, one grounded): ties R-13 B+ input lead, and B+ lead to S-1C.

TS-5 (two lugs, one grounded): ties C-12 to ground and T-1 primary lead to a lead that runs under the flange of the cabinet to J-3.

Non-rf carrying leads such as those for



filaments, switches, and so on, can be tucked away out of sight under the bottom flange of the cabinet.

L-2 will be sufficiently self-supporting if its leads are wrapped and soldered tightly around the ends of ¾" lengths of bus bar. The unsoldered ends of the bus bars may then be soldered directly to terminal lugs on C-9 and C-10.

It will be noted from the parts list that L-2 is used as is. There is no need to remove turns or otherwise modify the coil.

The mounting bar shown in the photographs of the transverter is located at the center of gravity of the cabinet, thereby facilitating proper mounting. It measures ¾" by 9", clearing all component mounting screws in the cabinet by a comfortable margin.

As shown in the photographs, it is necessary to bend down one mounting flange of T-2 to permit it to be secured to the top surface of the cabinet.

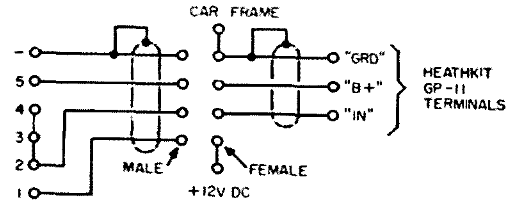
The two screws appearing farthest forward on the top of the cabinet in the front view photograph, incidentally, are merely hole plugs. The chassis used by the author originally mounted a home-brew power supply and the holes in question proved excess to transverter needs.

Tuning Procedures

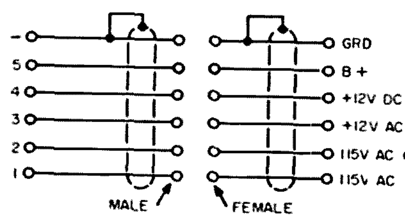
Peaking of L-1 prepares the transmitter section for on-the-air operation. Preferably, a crystal in the vicinity of 3.9 mc should be used for this purpose, or a VFO tuned to this frequency. Place S-1 in the "calibrate" position and switch S-6 to read final grid current. Then peak L-1. About 6 to 8 ma should be indicated by the meter. This will drop to 3 to 4 ma when the final is loaded.

To ensure that L-1 is in fact tuned to the 75 meter phone band it is well to check the fundamental frequency with a communications receiver, comparing the output with that of the second harmonic. The second harmonic should be noticeably weaker.

The pi-network tuning capacitors C-9 and C-10 are tuned in normal fashion to put the transmitter section on the air. Use of a dummy antenna is recommended (by the FCC) for initial tune-up and testing.



DC SUPPLY CONNECTIONS



AC SUPPLY CONNECTORS

The first step in tuning the converter section is to adjust L-6 for proper oscillation action. The simplest way to do this is to tune a communications receiver to 2.9 mc and adjust L-6 until oscillation occurs. Adjust for peak output consistent with rapid starting of oscillation upon application of plate power.

If a signal generator is available, set it for approximately 3.9 mc. With a broadcast receiver connected to the transverter, tune for the 3.9 mc signal in the vicinity of 1000 kc on the broadcast receiver dial. Once tuned in, peak L-5 for maximum output. Then set C-13 to half-capacitance and peak L-4. Once L-4 is adjusted, C-13 may be used for subsequent antenna peaking.

If test equipment is not available, the converter section can be satisfactorily tuned by using an on-the-air signal within the 75 meter phone band. Oscillator action will be evidenced by a rushing sound in the broadcast receiver as L-6 is tuned to resonance. Once oscillation has been achieved, look for a signal and then peak L-6, L-5 and L-4, as described above.

An S-meter on the broadcast receiver will, of course, facilitate tune-up of the converter section irrespective of whether test equipment or an on-the-air signal is used.

Parts List

All fixed capacitors are disc ceramic except C-11 and C-12, which are miniature electrolytics, and C-17 and

C-19, which are tubular ceramics

All resistors are ½ watt unless otherwise indicated on circuit diagram

C-9—409 mmf variable, midget TRF type, with 9 rotor plates removed to reduce capacitance to about 190 mmf (Allied Radio 61 H 009)
C-10—409 mmf variable, midget TRF type (Allied Radio 61 H 009)
L-1—36-64 yh slug-tuned coil (North Hills 120-F)
L-2—Air wound coil, 32 turns per inch, ⅝″ diameter, 2″ long (Miniductor 3008)
L-3—12 to 16 turns of No. 28 d.c.c. wire at cold end of L-4
L-4—36-64 μh slug-tuned coil (North Hills 120-F)
L-5—64-105 μh slug-tuned coil (North Hills 120-G)
L-6—105-200 μh slug-tuned coil (North Hills 120-H)
S-1—4 pole, 3 position, non-shorting, single gang rotary switch (Mallory 3243J) (one pole not used)
S-2—12 volt DC, 3 pole, double throw relay switch (Potter & Brumfield KA14 D)
S-3—2 pole, 3 position, non-shorting, single gang rotary switch (Mallory 3243J) (one pole not used)
S-4—Double pole, double throw toggle switch
S-5—Single pole, single throw toggle switch
RFC-1, -2, -3—2.5 mh, 200 ma radio frequency choke (Miller 6302)
RFC-4—10 mh, 125 ma radio frequency choke (National R-100U)
T-1—Single button carbon microphone input transformer to push-pull grids, ratio 1:64 primary to secondary (stancor A-4742) (secondary center tap not used)
T-2—14,000 ohm, 10 watt fixed impedance output transformer (Stancor A-2312) (secondary not used)
J-1, J-2—Motorola-type auto radio jack
J-3—Military-type jack for PL-68 plug (Little-Jax C-12B)

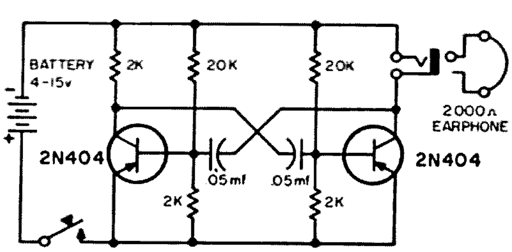
. . . WA6FPG

Transistor C P O

Anthony Savicky W3JYL
and
Robert Buzzard W3RRV

Having helped a neighbor and several of the fellows that we work with get their Novice and Technician licenses, we decided to build something a bit different in the way of a code practice oscillator, something small and compact. After trying several tube type oscillators, we came up with a circuit that seems quite excellent. It has been put to good use by a half dozen persons who wanted to build one like it, so we thought the information might be worth passing along.

The code practice oscillator is basically a



transistorized free running multivibrator generating a square wave signal at an audio frequency rate rather than the conventional audio sine wave oscillator that is normally used for code practice. The multivibrator produces a higher amplitude output than is ordinarily obtained from the same transistors generating a pure sine wave. The square wave signal has a higher harmonic content, resulting in a crisp tone very closely resembling the output of a communications receiver tuned to a good CW signal.

The capacitance coupling between the two transistors cause them to alternately switch from a heavily conducting to a non-conducting state. Transistor Q1 going into conducting will cause Q2 to be cut off for a definite period of time and vice-versa. The rate of switching (the multivibrator frequency) is determined by the resistance (20K) and capacitance (.05) of the circuit. The values given will cause the frequency to be in the proper audio range.

The unit is housed in a 2¼" x 2¼" x 4" aluminum mini-box. Two phone jacks are mounted on the box, one for the key and one for the headphones. The "chassis" is a terminal strip 2" wide and with six sets of terminals. All the components were mounted and soldered. The two terminals on one end were bent in slightly to hold the battery in place. The "chassis" was mounted on ½" insulated stand-offs and then secured to the mini-box. An Eveready #504 (15 volts) was used three to four hours a day for a week and showed no appreciable drop in the volume.

Rummaging around in the junk box, we came up with a small speaker with an output transformer which we hooked in place of the phones. The volume was enough for the unit to be used in a 9 x 12 room with five people copying code.

. . . W3JYL & W3RRV

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The Knight-Kit T-150

a test report

AT THE RISK OF HAVING the Hon. Ed. shake his old gray head in dismay over the corruption of the younger generation, I must admit that the Knight T-150 transmitter kit appeared this summer just in time to cause me to shelve plans for a home brew 150 watt rig at K9PWT. Since the T-150 is a new piece of equipment and is not yet too widely known, I have prepared a table of condensed specifications which appears elsewhere in this article.

The rf circuitry begins with a 12BY7 in a Clapp VFO, developing output voltage across one of three tank circuits: 3.5 mc (80M), 7.0 mc (40-10M), or 8.3 mc (6M). The next stage is a 6CL6 buffer which also serves as a modified Pierce oscillator when crystal control is desired. In this case the 12BY7 is disabled and 3.5, 7.0, or 8.3 mc crystals used.

Next in line is a 7189 buffer/multiplier stage driving a pair of neutralized 6146's in parallel. All rf stages are cathode keyed for CW operation. A 2.2K bias resistor connected across the key jack keeps high voltage off the key terminals and allows current to flow during key-up periods, stabilizing the power supply.

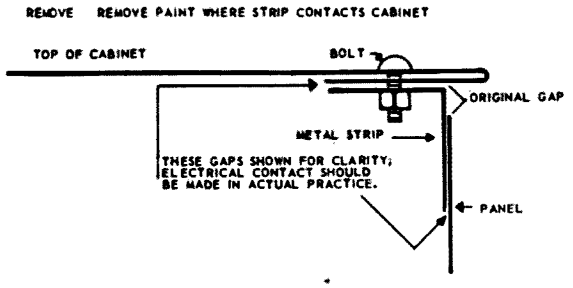
For phone work, audio voltage from a crystal or high-Z dynamic microphone is amplified by a 12AX7 and coupled to one grid of a

6DR7 twin triode modulator. A portion of the cathode voltage of the second half of the latter tube is applied to the 6146 screens to provide screen modulation with a type of carrier control. The operator at the other end of a QSO will report wide fluctuations in his S-meter reading, which is typical of controlled-carrier reception.

The power supply employs two solid state diodes in a voltage doubler, thereby saving both space and filament power, and eliminating a major source of heat.

Inspecting the 36 page assembly and operating manual, we find a page of illustrated soldering instructions and one of parts photographs; these are especially valuable in the sorting of the various types of machine screws, solder lugs, etc. There is also a page containing the resistor color code and photos of the common types of capacitors, and even a list of common CW abbreviations! Knight's usual enlarged assembly drawings are of course included. The schematic bound in the manual is 8½ x 11 and perfectly legible.

Evidence of the T-150's recent birth is provided by three supplementary sheets included with our manual. Two of these are devoted to minor circuit changes (2 resistors have been changed in value—the new components are



packed with the kit) and supplementary tuneup instructions, while the third contains additional comments on VFO alignment. To round out the manual we note three suggested methods of VFO calibration, operating instructions, a resistance-check chart, trouble-shooting hints, a circuit summary, and a parts list. However, we noticed that the tuneup instructions (which will be covered in detail later) did not mention explicitly the plate meter indications to look for when using the type of controlled-carrier/screen modulation employed in the T-150. Briefly, the story is this: while the final power input ratings are the same for both AM and CW, the AM rating refers to peak envelope power input[1], which is not followed by the plate meter. Call the plate current when tuned up for maximum CW output I milliamps. Then on AM, the no-signal plate current is about ½I, and the meter should kick up on voice peaks to around ⅔I. Any attempt to get more indicated power input by cranking up the gain control will only result in splatter as peak clipping sets in. Of course, an outboard clipper will help to raise the average modulation percentage.

In addition, we should mention for the record one typographical error in the manual: page 9, 12th construction step—"S-1A" should instead read "S-1B."

Actual construction time was 20½ hours, broken down roughly as follows: preliminary mechanical assembly—3 hrs.; wiring—16½ hrs.; final wiring check—1 hr. VFO calibration took less than one additional hour. No effort was made to rush construction. Most of the following notes on construction were made while assembling the kit.

The VFO tuned circuit components are mounted on a 2-piece subchassis for added rigidity and convenience in prewiring. The rotary switches used for band, xtal/VFO, and function switching are prewired before installation in the chassis. Perhaps this technique could be extended to some of the tube sockets, as there are a few tight spots in the layout. A pencil-type iron is indispensable here.

During the later stages of construction, L-shaped support brackets are temporarily screwed to the chassis to prevent damage to topside components when the transmitter is inverted for wiring. These are removed before installation in the cabinet.

There exists the possibility of momentary confusion when it comes to the identification of the multiplier tank coils, two kinds of coil identification being employed in our kit (although the manual indicates that one or the other will be used exclusively in the future). The surest way to avoid trouble here, and the best advice for any kit builder, is simply *read the entire manual and inspect the parts before starting construction.*

The only physical aspect of the transmitter in which I feel improvement could be made is the matter of rf shielding. The T-150, like its low-power predecessor the T-60[2], employs a one-piece wraparound cabinet fastened to the rear chassis apron with self-tapping screws; these provide the only positive contact between the chassis/panel assembly and the cabinet. In our kit, normal production tolerances permitted a gap to exist between the top of the recessed panel and the top of the cabinet when the transmitter was assembled. This provided a fine unwanted slot antenna. The most direct way to remedy this is to use a strip of electronic weatherstripping or aluminum angle stock placed so as to bear on the panel and cabinet after assembly, thus sealing the gap. See sketch. No TVI has been noticed with this seal.*

A welcome feature of the T-150 is the inclusion of provisions for an external plate modulator for those wishing to realize maximum output power. All necessary circuit connections are brought out to an octal socket at the rear of the chassis, and the manual includes details of the hookup required. (Remember to include the screen current if you use plate modulation). Similarly, an 11-pin socket provides switched 117 vac for an external antenna relay, a pair of terminals for externally controlled transmit/receive switching, and power connections. Voltages supplied to the pins are 700 vdc @ 50 ma, 300 vdc @ 50 ma, and 6.3 vac @ 0.5 a. This assortment is particularly attractive for the powering of a signal monitor of the Simplescope type[3]. In addition, an adaptation of Pafenberg's breakin and push-to-talk circuit[4] appears to be quite feasible.

The tuneup procedure is somewhat different from that usually employed with pi-net trans-

*Mfgr's. Note: K9PWT reviewed an early production of the T-150. Present units do have top of panel fastened to case, plus extensive added internal shielding. Present owners can obtain added shielding from Allied no charge.

mitters. The panel meter can be switched to read buffer grid current, final grid current, final plate current, and relative output. For relative output measurements, a sample of the rf output voltage is rectified and applied to the meter. After tuning the oscillator and buffer tank circuits to obtain maximum buffer and final grid currents respectively, the meter is switched to Relative Output. Now one of two procedures is followed, depending on whether operation will be on 6M or 10-80M. For 10 through 80, the Function switch is set to AM and the Final Tune and Load controls are simultaneously adjusted for maximum indicated output. The Function switch is then thrown to CW and the operation repeated. You are then ready to plug in your mike or key and get on the air.

On 6M, after tuning up in the AM position the capacitance of the Load capacitor is decreased enough to bring the key-down plate current to 250 ma. The Final Tune control is then adjusted for maximum indicated output.

Notice that the familiar "dip and load" procedure has been eliminated. Knight points out that maximum power output may possibly not occur at the plate current dip. The "Final Plate" position of the meter switch, besides being used in 6M tuneup, is employed in making sure that the plate current does not exceed 250 ma at maximum output. If it does, the buffer tank can be detuned slightly to bring it back down.

The entire tuneup procedure takes longer to describe than it does to perform. As I did not have an rf wattmeter available when testing the rig, the trusty light bulb dummy load was pressed into service to check the manufacturer's claims of output power. On 80-15M, the T-150 drove a 100 watt bulb to nearly full brilliance; on 10 and 6 it did a very creditable job with a 60 watt bulb. It appears that the Knight people know whereof they speak.

The rig is unusually handsome. The panel is two-tone gray with mirror-finish trim, while the cabinet is a medium gray hammer-tone. Meter and VFO calibrations are white on black, and the control knobs have aluminum disc inserts. A touch of color is provided by the red pin jacks used as a front panel crystal socket. The philosophy of the panel design seems to be to assign knob sizes in proportion to frequency of use during an operating session. A result is that the Function (i.e., transmit/standby) switch has a medium-sized knob which stands out from the five small knobs aligned with it along the bottom of the panel. This can be a great boon at the conclusion of

a hard night's operating.

The T-150 has been in operation at K9PWT for only a short time. However, I can say that it has proven fully satisfactory for a controlled-carrier rig of the 150 watt class. I have not checked the VFO drift rate (Knight claims 200 cps in 20 minutes after a 10 minute warm-up), but I have held 45 minute QSOs without having to touch the knob to get back on frequency. As should be evident by this time, I think Allied Radio Corp. and the Knight-Kit division have come up with a fine low-cost transmitter in the T-150. . . . K9PWT

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[2]73 Tests the Knight T-60 Transmitter, W4WKM, March 1962, 73.

[3]The Simplescope, WφOPA, p. 10, September 1961, 73.

[4]Break-in and Push-to-talk for the Knight T-60, W4WKM, p. 58, August 1962, 73.

CONDENSED SPECIFICATIONS

Frequency Coverage:	80-6 meters crystal or self-contained VFO.
DC Final Input:	150 watts on 80-10 meters; 100 watts on 6 meters, CW or controlled-carrier phone.
RF Output Power:	90 watts on 80-15 meters; 55 watts on 10 meters; 40 watts on 6 meters.
AC Power Required:	115 volts nominal; 180 watts on standby, 280 watts on AM, 350 watts on CW.
Output Circuit:	Pi network, matches 40-600 ohm load.
Size:	8½ x 17 x 10½ inches, height x width x depth; 28 lbs.

Scopes and Such

Staff

Undoubtedly, you've heard about using a scope to monitor modulation level. If you're an SSB addict, you might even have one in your shack. But do you know just how much you can actually see with a simple scope?

For instance, did you ever check your carrier for harmonics, using the scope? Or measure the *other fellow's* modulation (a good way to lose contacts rapidly, we might add, if you give honest reports)?

Other uses include determination of proper operating bias (even for AM transmitters), tracking down of parasitics, neutralization of the transmitter, and determining the proper impedance match between the modulator and the final. Except for the technique of measuring modulation percentage at the receiver, all of these things can be accomplished easily with a completely basic scope; by swiping high voltage from the transmitter power supply, you can build a perfectly adequate instrument for almost pennies (later on, we'll tell you how).

For a start, though, let's examine these various uses of the scope.

In checking out transmitters, you have a choice of three basic types of screen pattern. They are the trapezoid (most popularized), the wave-envelope, and the block.

The trapezoid, obtained by applying modulated rf from the rig's output to one pair of the scope's plates and audio from the modulator to the other pair, is basically a picture of the relationship between instantaneous af voltage and the corresponding rf output voltage. A typical pattern showing 100 percent modulation with no transmitter troubles appears in Fig. 1.

The wave-envelope, obtained by applying modulated rf from the rig to one pair of plates as before but feeding a regularly recurring sweep voltage (such as 60-cycle ac from the power lines) to the other pair, is more a picture of individual audio cycles as they are transmitted. Fig. 2 is a typical pattern showing clean, 100 percent modulation.

The block, not so well known as the other two patterns, is obtained by applying rf output (either modulated or unmodulated) from the rig to one pair of plates. The other pair is fed a recurrent sweep voltage, which again may be 60-cycle ac from the power line. The difference between the wave-envelope display and the block display of a modulated wave is that the modulating frequency should not be greater than four to five times the sweep frequency for a wave-envelope, but should be at least 10 to 12 times sweep frequency for a block.

The trapezoid and wave-envelope patterns are useful primarily for checking modulation percentage, operating bias values, locating parasitics, and determining proper modulator-to-final impedance matching.

The block pattern, though it may be used to

determine modulation percentage at the 50- and 100-percent points, is useful primarily for finding harmonics in the radiated carrier.

Neutralization may be checked with either the trapezoid or the wave-envelope patterns, but is most easily done with a special hookup which is described farther down in this article.

To show more clearly the hookups for getting the three main types of patterns, Fig. 3 details the connections for each. Note that in each case, the rf is shown connected to the vertical plates. The scope will work just as well with rf on the horizontal plates, but the pattern will be rotated 90 degrees to the right or left, from that shown in the illustrations.

If you get patterns which appear drastically different from the illustrations, such as those in Fig. 4, you probably have phase problems. Try getting the audio voltage from a different point; this will usually solve the problem.

Let's examine the carrier for harmonics first; connect the scope for the block diagram and fire up with unmodulated carrier. Then look at Fig. 5, where approximations to the pattern you'll see are shown (since the block appears as a rectangle of light, it can't be shown accurately on the printed page).

If the pattern you see is like that at the left of Fig. 5, a rectangle of light bright at the upper and lower edges and without streaks inside, your carrier is relatively free of harmonics.

If, however, your pattern resembles that at the right of Fig. 5, with irregularly spaced bright horizontal streaks within the light rectangle, you have some checking to do. The carrier is badly harmonicized, and you're courting FCC troubles.

Now, without changing the setup, apply modulation. Just talk into the mike, if you like (no need for sine-wave input at this stage). Streaks, similar to those caused by harmonics, should appear. Absence of the streaks indicates that you have no "talk power."

If you get a single bright line dividing the pattern in half horizontally, you're in business: this indicates 100 percent modulation. Two lines dividing the screen into thirds indicates 50 percent modulation, and a greater number of lines indicates even lower modulation percentage.

However, to measure modulation percentage more accurately, you'll have to switch over to the trapezoid pattern. With the trapezoid, you need a steady sine-wave input (but 60-cycle from a filament line is okay) to provide a steady pattern on the screen if you're going to measure accurately. For a rough indication, you can just talk. But no whistles, please!

To get an accurate measurement of modula-

tion percentage, measure the vertical edges of the pattern. You can use millimeters, inches, or any other units you prefer. When you have measured both edges, take the sum and the difference of the two measurements. Divide the difference by the sum, multiply by 100, and the result is your modulation in percent.

Thus, if the left edge of your pattern is 1 inch high and the right edge is ⅛ inch, call your unit of measurement eighths of an inch. The sum becomes nine and the difference 7. Dividing 7 by 9 gives you 0.7777777. Multiplying by 100 gives you the answer: 77.77 percent modulation.

This is the main use of the trapezoid pattern by most of us who use scopes at all; however, it can tell you much more. If the final isn't modulating properly, the trapezoid pattern will show you exactly what's wrong. Fig. 6 shows some typical "problem" patterns; the letters in the following paragraphs refer to patterns in Fig. 6.

If you don't have enough grid drive, the output can't be linear on the positive peaks of audio. The resulting trapezoid is shown as A; the bulge outwards on the narrow end indicates lack of drive.

Over-drive, or too much bias, produces a pattern almost the opposite, with an inward curve (B).

A combination of too little drive and too much bias produces the pattern of C; this is

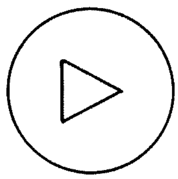


FIG. 1 NORMAL TRAPEZOID PATTERN

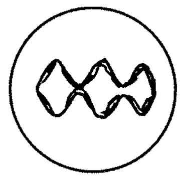
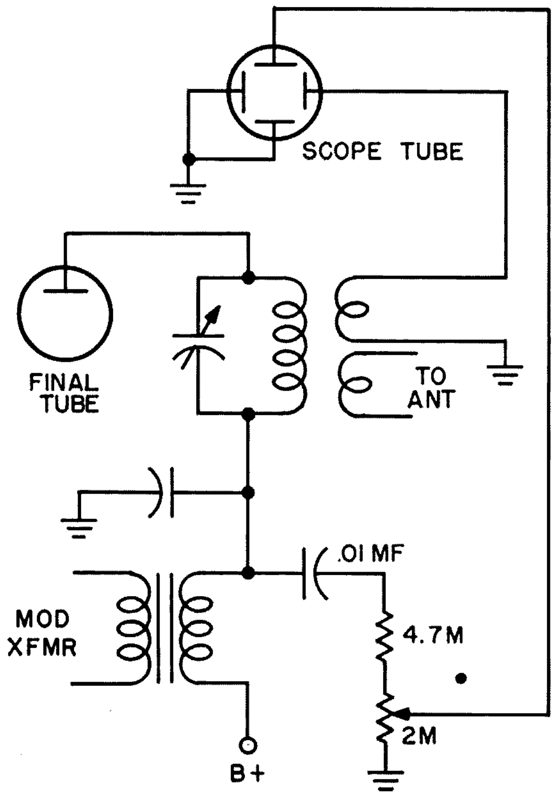
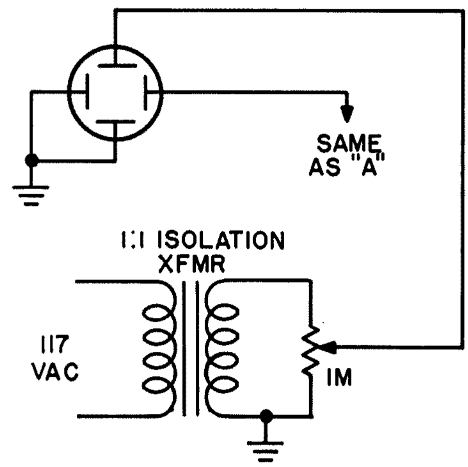


FIG. 2 NORMAL WAVE-ENVELOPE PATTERN



"A" TRAPEZOID HOOKUP



"B" WAVE-ENVELOPE HOOKUP (MODULATE WITH 180 CPS SIGNAL)

"C" BLOCK HOOKUP — SAME AS "B" BUT MODULATE WITH 1 KC SIGNAL

FIG. 3. SCOPE HOOKUPS

similar to the over-modulation pattern of D, but close examination shows the difference. The over-modulation pattern has straight sides and a narrow tip; the over-bias under-drive pattern has curved sides and a wider, sloping tip.

Not all the troubles are traceable to bias and drive. Parasitics are frequently troublesome in AM rigs; even when they're absent under CW conditions, they may appear during portions of the audio cycle and break the modulation up so badly that it's unreadable.

An example is shown in E; this rig is breaking into oscillation at the peaks of the audio cycle. Although the pattern is reasonably clean during most of the cycle, the sharp pip at the left indicates the oscillation; the on-the-air effect may range from "splatter" to complete unreadability, depending largely on the frequency of the parasitic.

Another example appears in F. This time, the oscillation starts as the audio cycle starts upward, but stops at the audio peak. The emitted signal would be completely unreadable.

Many such examples could be shown, but the most general way to look at it is this: if you get a pattern showing a sharp pip anywhere in it, look for a parasitic or two.

If the trapezoid pattern fails to show you what's wrong, the problem is probably distorted

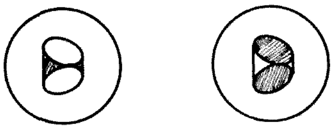
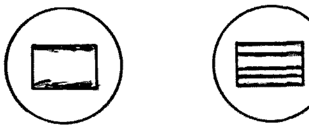


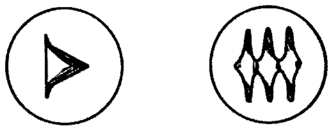
FIG. 4 TYPICAL OUT-OF-PHASE TRAPEZOID PATTERNS



HARMOMC-FREE CARRIER

CARRIER WITH BAD HARMONICS

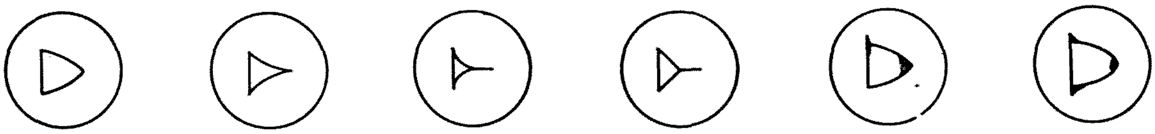
FIG. 5 CARRIER BLOCK PATTERNS



A

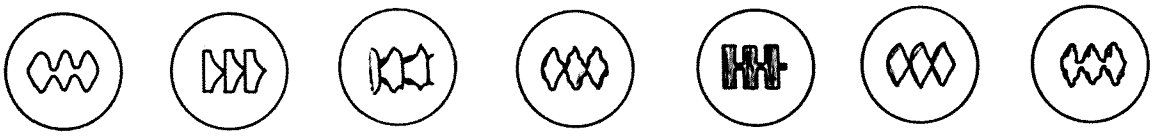
B

FIG 8. IMPERFECT NEUTRALIZATION OISPLAYS



A B C D E F

FIG. 6 TYPICAL "PROBLEM" PATTERNS



A B C D E F G

FIG. 7 TYPICAL WAVE-ENVELOPE PATTERNS.

audio. The trapezoid pattern, being a picture of the modulating process itself, doesn't care about the *shape* of the modulating signal. It gives the same picture for square waves or sine waves, providing the final operates in the same manner for each. This is the time to switch over to the wave-envelope pattern.

Like the trapezoid, the wave-envelope pattern requires a sine-wave input. Its frequency should be three to five times that of the sweep, and they should be synchronized so that the pattern displayed is stationary.

For best results, a service-type scope with a sawtooth ("linear") sweep is recommended, since with this instrument you can get a true picture of your sine-wave input.

If everything is working right, you should get a pattern that looks something like Fig. 7-A. However, if everything *was* right you probably wouldn't be going to the trouble of using the wave-envelope presentation.

So the other patterns in Fig. 7 are typical representations of some common and not-so-common difficulties as displayed in the wave-envelope pattern.

Shown at B is the display resulting from an over-driven speech-amplifier stage. At C is another display resulting from the same cause but with a much lower percentage of modulation.

Overdriving the *first* speech-amplifier stage resulted in the pattern shown in D, while "saturation" operation of a speech amplifier caused E. The pattern at E, incidentally, is typical of audio-clipper patterns and—if controlled—is not a defect. Without proper filtering, though, such an audio signal produces rf signals many, many kc wide!

Unbalance of a push-pull modulator will show up looking like F. Note the non-symmetrical sides of the peaks, and the sharp "V" at the valleys. Overdriving of the modulator stage itself may show up as in G, or may look the same as E.

A while back, we mentioned using the trapezoid and wave-envelope patterns to check neutralization. Fig. 8 shows some typical patterns of this sort. The trapezoid is shown at A (note similarity to Fig. 6-E) and the wave-envelope pattern at B. If you leave the scope hooked up permanently to measure and check modulation, these patterns can show you how your neutralization is at the same time.

But a simpler way of doing it is to make a special scope hookup. Fig. 9 shows how. The Vertical input of the scope is hooked through blocking capacitor CI to the plate of the stage being neutralized, while the Horizontal input is hooked through blocking capacitor C2 to the grid.

With plate voltage to the stage turned *OFF* but all other operating voltages (except screen, in the case of tetrode and beam-power tubes!) applied, first tune the grid circuit to obtain maximum horizontal deflection of the scope trace. Next, tune the plate circuit to obtain a horizontal ellipse such as that shown in Fig. 10 at I. Finally, tune the neutralizing adjustment to obtain a single-line horizontal trace (II, Fig. 10).

If the output contains a fair percentage of second-harmonic energy, you won't be able to get the straight-line display of II. Instead,

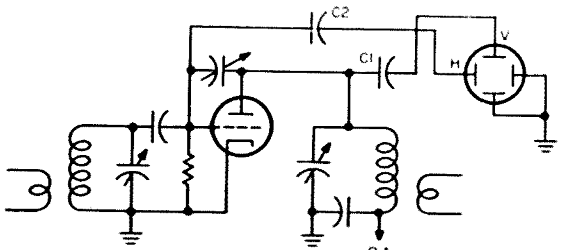


FIG. 9

FIG 10

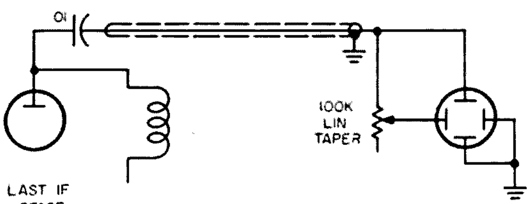


FIG 11

FIG. 12

you'll get the "infinity" sign of III when neutralization is proper.

If the plate tank is not properly tuned, your ellipse will be tilted to one side or another, as in IV.

The hookup for measuring the other fellow's modulation at the receiver has been published before, but is still not widely used. It is similar to the trapezoid display but shows up as a "doughnut" on the screen. Only one connection to the receiver is required.

Make the connections as shown in Fig. 11, to the final *if* stage of your receiver. Then tune in a steady, unmodulated carrier, such as the signal from a frequency marker oscillator, and adjust potentiometer R to get an ellipse such as A in Fig. 12. This completes the set-up.

Tuning across your favorite band, you'll find that the ellipse appears sharp only when you're turned to an unmodulated carrier. Modulation makes the sharp line blur into a ribbon, or a "doughnut of light" on the screen. When modulation reaches 100%, the dark spot in the center (or the hole of the doughnut) vanishes as the edges touch. Overmodulation replaces the dark spot with a bright patch of light.

To measure modulation of an incoming signal in percent, measure the inner and outer diameters of the doughnut at its widest point. Take the sum and difference, divide the difference by the sum, and multiply by 100. But be cautious about giving modulation reports with this system, since an alarming number of signals on the air today carry only 10 to 25 per-

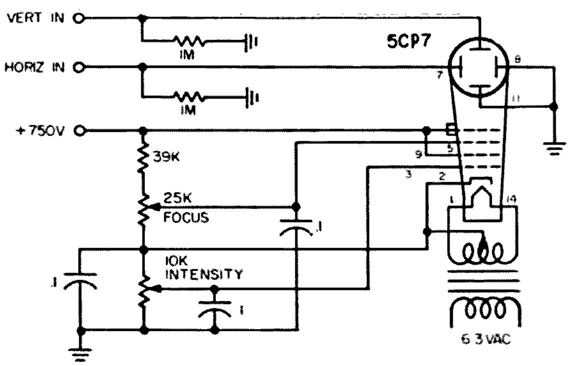


FIG. 13

T M

cent modulation!

By now, you should be sold on the advantages of having a scope. Here's a fast and simple way to build one.

Materials required are a scope tube (many 3- and 5-inch radar-type tubes are available in surplus for fantastically low prices, such as the 15 cents we paid for a 5CP7), a filament transformer to match, four potentiometers, a small handful of 1-watt resistors, and a box to house it all. The box can be made of wood if you prefer.

Wire it all together as shown in Fig. 13. The high voltage is stolen from the transmitter supply, and should be somewhere between 400 and 1500 volts. Only a few mils are needed, but since the transmitter supply can produce much more, take extra care with the wiring to make sure you'll never be able to get across the high voltage!

Resistor values shown in the schematic are for a 5CP7 with 750 volts applied to the HV input; for other tube types or other voltages, you'll have to refer to the tube characteristics (see ARRL handbook) and calculate resistor values from Ohm's Law. The bleeder string should dissipate as much power more than the total of all electrode currents, to maintain effective control. Thus, if the total of all the electrode currents is 5 ma, the bleeder should be designed to draw another 5 ma through it alone.

Naturally, such a simple scope is limited in application; you can frequently find used service scopes in the shops for $40 or less—or you can put one together from a kit for only a few dollars more. Either way (build, buy, or kit) you'll soon find yourself wondering how you ever got along without one.

[Linear from page 25]

position for a positive-off indication. In the on position, it energizes the power transformer and a red pilot light. A 117 volt outlet on the rf amplifier chassis provides a connection for the separate plate supply transformer.

The plate power supply can be any conventional power supply. The 3-1000 Z needs a minimum of 2500 volts. It will barely make the kilowatt level before limiting at this voltage. It works very well at 3000 volts, and will deliver 1300 measured watts into a dummy load at this voltage. It works even better at 3500 volts and is perfectly safe as far as tube failure is concerned.

The power supply shown in the schematic uses a Thordarson 3800 volt 1200 volt-amps power transformer #T-44928. A full wave bridge of Diodes Incorporated* DI-26 rectifiers is used. These rectifiers have the reputation of being under rated, so only 10 rectifiers in series per leg is used. But it is recommended that more, up to 15 per leg, be used. The picture of the rectifiers and the transformer shows only ten. (Fig. 4) The rectifiers are mounted on a tie point strip from a piece of surplus gear. The larger DI-56 rectifiers would give more safety margin (and more current), at more cost.

The cost of the silicon rectifier system is comparable to the cost of four 872 rectifiers plus the bridge type filament transformer and has the advantage of saving space, less heat, and simpler switching. However, the silicon rectifier system will not stand short circuit overloads as well as the thermionic systems.

Power supplies, built since this rig was designed, using solid state rectifiers have shown better transient resistance by the addition of a .0001 mfd discap capacitor and a 1 meg ¼ watt resistor in parallel with each individual rectifier of the system. This is on the advice of Ozzie Jaeger, K3OKX who designs and man-

ufactures many solid state devices for Westinghouse.

The filter system uses the resonant filter choke (120 cycles) and 8 mfd at 4 kv. The filter choke is a Thordarson .5 ampere *smoothing* choke, tuned with a .1 mfd at 7500 volts oil filled capacitor. The resonant filter system makes it possible to use a higher value bleeder resistor (less wasted watts), and still maintain good voltage regulation. The voltage drops 150 volts from plate idling current of 200 ma to full power of 800 ma.

The T-R switch shown in the schematic is a Jennings type RB-3 vacuum switch. It is mounted in the co-axial line some distance from the amplifier, but could have been advantageously mounted on the amplifier deck. The RB-3 TR switch is in two decks. The upper deck switches the antenna from receiver to transmitter. The lower deck removes the blocking bias on the final and mutes the receiver in the transmit position, or blocks off the final and actuates the receiver in receive position. The interesting feature is the timing on the vacuum switch. The RB-1 Jennings vacuum switch is timed so the top deck (antenna T-R) closes 5 milliseconds before the bottom deck. This means the antenna will be switched to the transmitter 5 ms before the transmitter is energized, assuring a load on the transmitter. Then on opening, the lower deck releases 5 milliseconds before the upper deck, assuring that the transmitter will be turned off before the load is removed.

These vacuum relays are available with various coil voltages. Here a 115 volt dc coil was used with four DI-26 silicon rectifiers mounted in a bridge on its terminals, converting it to 115 volts ac. Then, the 115 vac terminals of the T-R switch are brought out and connected to the keyed 115 vac on the back of the exciter, a SSB-100F. From this the voice operated relay in the exciter actuates the final and mutes the receiver.

The blocking bias for the final is obtained from a thousand ohm 10 watt resistor in series with the bleeder resistor. The bleeder resistor is made up of five 10,000 ohm 80 watt surplus resistors.

This standby and metering circuit looks (and is) simple, but it took quite some figuring. The credit goes to Buddy Alvernaz W6DMN. The plate current meter, in the negative lead of the power supply, reads only plate current—no grid current, and the grid blocking system

* Diodes Inc., 7303 Canoga Ave., Canoga Park, California

[Turn to page 61]

[Linear from page 59]

works. It was difficult to get a circuit that would do both.

A Linear System* directional coupler is connected in the output to give indications of SWR & output.

The plate blocking capacitor is a TV ceramic 500 mmfd 10 kv unit. The parasitic suppressor is made from a 50 ohm 16 watt surplus globar resistor with 3 turns of #10 wire around it. The use of the heat radiator on the plate of the 3-1000Z is a must.

The plate rf choke could be a national R-175-A. The one shown is a home made version, cut on a lathe from teflon, to the R-175-A dimensions and wound full of #24 manganin cotton insulated resistance wire.** The use of resistance wire in rf chokes is a real winner. This spoils the Q of the inevitable self-resonances in the choke. With a lower Q goes lower circulating rf currents, which is the Gremlin that usually burns up your plate choke. Unfortunately, the insulated resistance wire is hard to obtain. Due to lack of demand, retailers seldom carry it, and the manufacturer will sell only full spools.

If all interested in some of this wire were to channel their inquiries to the same distributor, he would have enough requests to warrant putting in a small stock of it. A telephone call to Pete Phelps W6ERP, Quement Electronics,*** confirms this theory.

I suggest that all who are interested, write to Pete for fifty feet of #26 Manganin cotton covered resistance wire. This can be wound on a ceramic insulator, a tooth brush tube, or what have you for a really fine KW 3-30 mc rf choke, The National R-175-A is even better than the original when rewound with resistance wire—after they burn up from internal resonances as purchased. Another way to prevent the rf choke from burning up is to put a 50 ohm resistor in series with the hot end. This should be an rf type such as a globar.

This particular arrangement of a 3-1000Z linear amplifier has proven to be quite satisfactory. In general however, the 3-1000Z grounded grid triod tube has proven to be a real winner. Give it a try for a linear with authority and reliability.

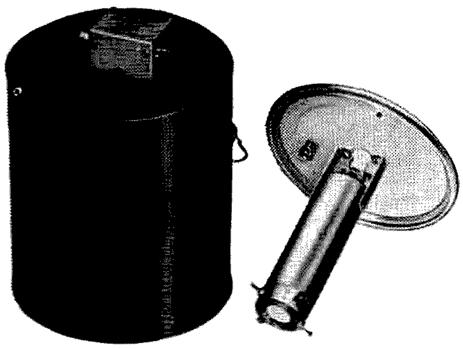
. . . .W6JAT

* Linear Systems, Inc., 605 University Ave., Los Gatos, Calif.

** Driver Harris Co., Harrison, N. J.

*** Quement Electronics, 161 W. San Fernando St., San Jose, California

Donald A. Smith—W3UZN
Associate Editor



The Heath Cantenna

MOST OF US HAVE made dummy loads out of everything from light bulbs to resistors. No problem for the lower amateur bands, or if the power into the load was small. When a dummy load is needed for VHF frequencies however, the problem becomes somewhat more complex. High power finals have also always created a problem.

Heath Company has solved these problems with a new low priced dummy load kit. From the outside it looks just about like a gallon bucket of paint, with the paint can black. A closer look reveals some interesting "guts," as we will see later. The specs on the dummy load are as follows:

Impedance	50 Ohms
VSWR	1.5 up to 300 MC 2.0 up to 400 MC
Power Dissipation Capability	1 Kilowatt max (ICAS)
Size	Gallon Paint Can (8⅞" high by 7" diameter)
Weight	1½ lbs. (without oil)
Building time	1½ to 2 hours
Price	9.95

A very special "resistor" is used as the load, which is a special combination of carborundum and other materials. It will withstand considerable amounts of heat, without making any great changes in it's resistance. Impedance is maintained by a special shield placed around the 50 ohm resistor. Transformer oil is placed in the can surrounding the load resistor and stabilizes the heat dissipation of the load.

It is interesting to note that both mineral oil or transformer oil have about the same heat conduction properties up to about 400 watts. Above that power level, transformer oil becomes considerably better. At full input power of one kilowatt, the power can be left connected for only about 2 minutes using mineral oil, while it may remain for almost 10 minutes if transformer oil is being used.

The type of oil you use in your particular "Cantenna" will be determined by the type of oil which is available to you in your locality. If both are available, the price will no doubt help you decide which to use. By the way, a good place to try to secure transformer oil is from your local electric company. I find that most of them use it themselves and in some cases will even let you have the relatively small amount which you need for nothing.

The little dummy load is very easy to assemble, though care should be taken in securing the silver plated connections on the 50 ohm load resistor. Also when mounting the shield tube, as this will have an effect on the over-all impedance. The top of the resistor is connected by tabs to a porcelain feed-through

terminal, then into a small metal box. The top of the "paint" can is where this box is mounted and contains special circuitry which permits the measurement of a dc voltage for monitoring relative output power.

I have used the load on amateur frequencies (also commercial "CAB" frequencies of 152 mc @ 100 watts), from 3.5 mc to 220 mc. Powers ranged from less than 1 watt to over 600. I have not as yet had a chance to connect a "full gallon" to the load, but I have fed it with the Heath Linear and found that the load can really take it. It's a real aid in checking out a rig, making adjustments, and looking for troubles without causing interference to amateur or other services. At less than ten bucks, it's a real good buy.

New Product

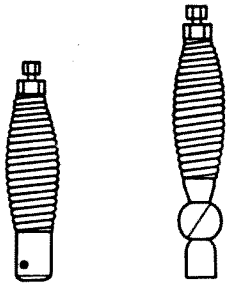
16th Edition Radio Handbook

Bill Orr, W6SAI, has done it again. Never mind the $9.50 price of this volume, it has over 800 pages and is the best text book for learning about radio that we've ever seen. It covers all aspects of radio theory and practice, is beautifully illustrated and climaxes each section of theory with some of the most up to date construction projects you'll see anywhere. This is like a huge long issue of 73, carefully indexed and integrated . . . and probably without as many mistakes.

The book is particularly strong on higher power transmitters, which is not too surprising since Bill spends his days at Eimac and obviously talked several of the Eimac gang into building up the beautiful rigs in the handbook.

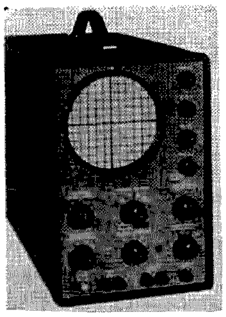
No active ham . . . and particularly no newcomer should be without this monumental reference work. It is available through many parts distributors or Radio Bookshop.

New Products



Mobile Antenna Springs

G.A.M. Electronics has two new antenna springs on the market. These use a special ferrule fitting to absolutely prevent your losing your whip. They are made of stainless steel to be non-corrosive. They are stiff enough to hold your antenna straight, but will bend when the clearance is low. Available in the standard base or ball joint base for mounting on angular surfaces. Write G.A.M., 138 Lincoln Street, Manchester, New Hampshire.



Scope Kit

Incipient scope purchasers would do well to drop EICO a line and ask about their new Model 427 Advanced General Purpose Oscilloscope. They've packed a lot of features in this one and the kit price of $69.95 should be interesting. EICO, 3300 Northern Blvd., L.I. City 1, N.Y.

DX'ers Meeting

The yearly DX gathering will be held January 26-27 at the Continental Wayside Inn, Paso Robles, California. For exact details and tickets write Lloyd Colvin W6KG, 111 Purdue Ave., Berkeley 8, California.

[W2NSD from page 4]

2) A discount will be allowed on all 73 publications.

3) Club members will learn of Institute activities through bulletins sent to affiliated clubs and thus can keep up to date on their hobby.

4) Club members will be able to participate in the affairs of the Institute through their club.

5) Clubs with 50% or more members subscribed to 73 will receive one each of all new 73 publications to be used as door prizes for meetings.

Virtue Rewarded, Sort Of

About a dozen editors of club bulletins have me on their mailing list. I have greatly enjoyed reading the papers and have been trying to figure out some way of making their extra effort in keeping me on their list worthwhile. When the next issue of these bulletins comes out I hope the members will be pleasantly surprised at the Christmas Certificate that is printed in there. Too bad if your club isn't sending me your bulletin.

Ten

Among the felows who liked my ideas last month about our setting up a channel on ten meters was W2HBQ who suggested that it would be very simple to set up an ac-dc radio with a small converter and a squelch (such as in Dec., 73). Old radios are all over the place . . . or you can get one of those $5.50 ones from Meshna . . . or for maybe 50¢ from a car cemetery. A thought.

Green Light for 420 mc

The FCC has announced that effective January 2, 1963 the power limitation on the amateur 420-450 mc band will be increased to the full legal limit of 1000 watts input with the exception of three areas of the country. Amateurs operating in these restricted areas will have to continue the present 50 watt power limit. The 50 watt areas are Central and Southern California (too bad fellows) below the 37° 10′ parallel (about halfway between Redwood City and Santa Cruz, leaving the Eimac boys the full gallon limit up in Palo

Alto), and on across Southern Nevada (Las Vegas). The entire state of Arizona is 50 watted. A little area around El Paso, Texas, reaching about 125 miles north, 10 miles west, 50 miles east and all the way south is limited too. Then there is the entire state of Florida plus a 200 mile radius of Patrick and Elgin Air Force Bases near Crestview and Cape Canaveral. These remove about 2/3 of Alabama, a good bit of Georgia and a little hunk of South Carolina. Fortunately New Orleans suffers a near miss. Near Miss. doesn't.

Even with these restricted areas this is a major step ahead for us. With the new power limitation we can start some earnest 432 mc work and step up Ham-TV operation. I'm wide open for articles on high power 432 mc rigs. If I ever get caught up enough on the magazine here I'll be down there on 432 myself. I've got some of the basics here, all I have to do is find the time to get 'em perking.

Ham Publication

It is frustrating to operate a booth at conventions. I find myself being repeatedly congratulated by well-wishers who like the magazine, a pleasant experience which is intermixed with anguish as other fellows walk by, obviously uninterested in the whole idea. These chaps are radio amateurs too. Here we are publishing a magazine that thousands of amateurs think is wonderful and yet thousands more couldn't be less interested. What gives? If I leap out of the booth and grab their lapel they protest that they already get a lot of magazines which they don't read, so why get one more. Or else they admit that they don't read any ham magazines and don't see why they should.

The problem probably is that I take ham radio too seriously. I've lived so intimately with the hobby all my life that I can't project myself as a casual participant. I've been gung-ho for all amateurs to subscribe and support all

amateur publications ever since I started in the hobby, and many years before I even had the faintest hint that I would ever be working for a ham magazine. It is axiomatic that the more you know about what is going on the more enjoyment you receive from anything.

Maybe they are saving the money. How much could it cost to support all amateur radio publications and encourage them? 73 is $3.50; QST is $5; Western Radio Amateur is $2; VHF Horizons is $4; The Monitor is $1.50; Auto-Call is $1; and (ugh!) CQ is $5. This totals $22 a year. If you are interested in DX add $7 for DX Magazine. Twenty-two dollars, spread out over the year, is little enough to invest in your own enjoyment and the support of the hobby through its publications.

This sort of talk is detrimental to my own survival since most of the magazines are competing for the advertising dollars and the fewer magazines there are the easier it will be for the others. Even so, I feel that I don't mind sacrificing a little bit to keep most of the ham publications going. Three ham publications have sunk from sight in recent months and three or four more are rapidly headed in that direction unless you step in there and support them. You'll get better publications if you support the ones that are trying to make a go of it now instead of waiting to see how they make out with the result that they don't. True, new publications seem to spring up to fill what little gap has been left, but these too fade away when the money runs dry.

Choosy

If you look over our ads I think you'll find that we are the most particular of all of the ham magazines about advertisers. I refuse to knowingly accept an advertisement from a company that I believe is not manufacturing a good product. Even though we emphasize the VHF's quite a bit there are two VHF equipment manufacturers that you will not see in 73, though they do advertise elsewhere. There is one large antenna manufacturer in the same boat.

Please let me know if you disagree with my decisions on advertisers for I don't want to have any readers run into troubles. We will not be bribed into accepting ads from chislers no matter how much we need the money.

Classified Ads

How come we don't have 'em? Mostly because we don't have enough staff to handle the work involved. We're already trying to tackle more than we can handle efficiently. We

have been overwhelmed recently by subscription renewals, articles, book production, newsstand expansion, changing printers, and advertising. We have been underwhelmed by money.

Homebrew Contest

The Schenectady Amateur Radio Association has a little idea that many clubs might think about. They are running a homebrew contest which will come to a head next May when they have a special meeting for everyone to bring in their homebrew gear and prizes will be given for the neatest wiring job, the best looking workmanship and the most unusual application or design features. I'm sure that local parts distributors will offer up some prizes if your club decides to put on an event like this.

Hands

We're pretty well set right now on staff here at 73, but come this summer we can use two or three poor but honest fellows who would like to live neck deep in ham radio for a couple of months. I guess I'd better warn you, we work hard here, we don't know what a weekend is, we work from morning until late at night, there is hardly any pay at all, absolutely no smoking or drinking, and we have a heck of a lot of fun dodging bankruptcy and other emergencies by frantic bursts of effort.

That doesn't sound very encouraging I suppose, but the whole staff lives right here together and we have a lot of fun. There is an unlimited number of things to learn and nobody to stop you. If you really want to learn and are 19 or over drop me a note.

Printed Circuit Kit

Though most of the printed circuits that are published in articles in 73 are available from Irving Electronics, there unquestionably are a lot of fellows who would like to either make their own boards for these articles or perhaps whip up some boards for gear of their own design. This is good . . . this is progress. And Ham Kits down in Cranford (Box 175) New Jersey has a little kit for you with complete instructions, a couple of 5" x 7" copper clad boards and everything else you could want to make your own printed circuits. $2.00.

Hy-Cain

We're not the only ones with new buildings. Hy-Gain has just moved into a huge new building out in Lincoln, Nebraska where they

will be able to better keep up with the demand for their beams. We're hoping that they'll make some of the results of their antenna test site available for us to print in 73. In the meanwhile we're doing fine with our Hy-Gain tribander here at the 73 HQ.

RTTY

Fellows keep asking how they should go about getting on amateur radioteletype. I'll encapsulate it for all interested parties.

1) You'll need a printer, a converter, and the usual receiver and transmitter. Printers can be purchased for a very reasonable sum ($100 or less, frequently) through your nearest RTTY Society. MARS programs have been distributing them rather freely too. And there always are the ham ads. You might check with W1AFN, W2ZKV, W3CRO, W4RWM, W5ANW, W6AEE, W9GRW, or WφATM. There are two commercial converters on the market (see Alltronics ad in this issue for one), a couple available surplus and any number of simply build home-made units. One of the best we've seen was in the August 1961 issue of 73 and consisted mostly of an inexpensive printed circuit board.

2) You plug the converter into the phone jack on your receiver and the printer into the converter. Presto: the written word.

3) After the initial shock has worn off you will get the hankering to talk back. If you have a transmitter like the Central 200V all you have to do is plug into the converter and you are in business. If your oscillator does not have an FSK circuit you'll have to build one. Fortunately this is a matter of a few minutes. A small variable condenser in series with a 1N34 or other small diode will allow you to key a small added capacity across the oscillator and vary its frequency by the required 850 cycles. A dc voltage fed through an isolating rf choke to the diode switches the capacity off and on.

4) Have fun.

RTTY Sweepstakes

Though I'd read in the RTTY bulletin that there was going to be an RTTY contest, I really hadn't given it a lot of thought. Then, the other night, I had just returned from a trip down into Massachusetts to pick up some tropical fish for Virginia and, as I tuned the bands, I heard a terrific clatter on the RTTY channels. Fortunately my Model 15 was all tuned up and ready to go . . . John, WA2FMF, had visited that day and checked it for us.

We quickly hunted around and dug up the patch cords for the new Alltronics Converter and soon were getting good copy. The 200V

had only to be plugged into a polar relay and we were on the air. It didn't take long to find out that the 80 meter antenna had come apart . . . and the tribander was down with rotator troubles. I fumed. Even with the broken antenna I managed a few 80 meter contacts and a QRZ on 20 meters from a YV.

Bright and early the next morning we set to work getting the antennas back up. I cut a folded dipole for 80, which we hung from the 100' Rohn tower to a tree. The tribander was swung back up on the E-Z Way tower and we were all set.

Unfortunately there was a lot of magazine work to do so I couldn't spend the entire weekend on the air. I worked about 25 states and four countries . . . and heard ten countries more that I didn't have the patience to work, including a ZKI! RTTY has come a long way. One contact that stood out was with W6NRM. The last time Bob had copied RTTY signals from me was over 13 years ago.

RTTY BOOK

It took us a lot longer than we figured to turn out our promised RTTY book. Naturally we have a whole set of lame excuses for this and by the time we got through explaining you would probably be moved to tears.

The book is frankly written for beginners and does not go into the complications of designing circuits or heavily into the theory of RTTY. It tells you what you need to put an RTTY signal on the air, where to get your printer, how to build or buy a receiving converter, how to connect into your transmitter, and just about everything else you really need to know to get on the air and have fun without becoming an expert. A great deal of space is taken up with photographs of the various types of available commercial equipment and considerable valuable discussion is presented to help you choose your printer, tape equipment and other accessories. MARS members will find the data on military gear invaluable.

The book is designed to compliment the articles that appear in 73. There are a couple of reprints from our earlier issues, but other than that all of the material is new and unavailable elsewhere.

The original price of the book was $3.00. We have cut a lot of corners in the production of this book. Most of the photographs were taken of my own equipment, many of the pages were prepared on our own Varityper and IBM Executive and the book has been printed by the less costly offset process. The finished product is very good (both the ARRL and Radio

Handbooks are offset printed now), and these economies enable us to sell the book for only $2.00 instead of the expected $3.00.

Fellows who have already sent in their $3.00 for the RTTY book will receive not only the book but a one year extension of their subscription to 73 as a reward for their patience in waiting for us to fuss around and get the book the way we wanted it before publication.

Two other books have appeared in the past on this subject. The first one was largely written by me and compiled by W2JTP. Much of the material in that book was lifted enmass out of the earlier RTTY columns I wrote for CQ magazine from 1951 to 1954. When that book finally went out of print W2JTP redid it with a few small changes and it was published by Cowan earlier this year at $3.95. It seemed to me that after ten years that someone should sit down and write something a little more up to date. W4RWM provided the framework and I filled in the bulk of this latest book. I'm betting $2.00 that you like it.

Special Sections

We're working on several special features for 73 which may be of more permanent interest than usual. The plans are to have a section devoted to a survey of the equipment that is available for six meter sideband work; one devoted to quad antennas, complete with a comparison of the various commercially built models; one on towers, comparing all of the makes of towers and a big special section in March on all of the receivers that are presently available either new or second hand. This receiver section will show pictures of just about every receiver made in recent years and give the specifications. We're short a few photographs and would appreciate readers sending them in for the: 75S1, S-27, S-37, S-41, SX-42, S-77(A), SP-400X(SX), AR-1, AR-2, HR-20.

A new manufacturer of sideband transceivers seems to pop up every few days. We're planning on a comprehensive on the commercial transceivers for April and would appreciate hearing from any manufacturers that have not already sent us photos and specs of their gear. It would be a shame to be left out of this section.

Motivational Research

Even a casual inspection of our subscription ads should show you that I have been trying every tack that I could think of to get more subscribers. None of my brainstorms seem to produce any special results, entertaining though they may be. OK, I give up. I'm ap-

pealing to you to tell me what factors have influenced you to subscribe or might influence you.

You may not be a subscriber to 73 at present, but in all probability you are subscribing to some magazines. Think back; what was it that tipped the scales and convinced you to send in your subscription? Perhaps you can let me know so I can tip the scales for other readers and speed up our expansion a bit.

Did they reach you through reason: it is cheaper to subscribe than buy on the newsstand; you sometimes can miss an important issue by depending on newsstands; you often have to look around quite a bit to find a stand that has a copy; etc. Or was it just persistence in sending you subscription reminders?

Are there any changes in 73 that would make you like the magazine more? Almost all of the fellows that write in now want us to keep it just as it is, but that doesn't mean that the fellows who are not subscribing like it this way. We are already publishing more feature articles than all the other ham magazines combined, so we can't do much more along that line. No, I believe that the magazine is good and it is only in our sales approach that we have failed. But maybe I'm wrong!

What do you think?

RM-341 Continued

In the interests of avoiding a court battle, for which I have neither the time nor money, it is prudent for me to retract the second sentence of the second paragraph on page 83 of the December 1962 issue of 73. This sentence said, "There were numerous reports of TVI in which he was uncooperative, complaints of overpower, complaints of excessively broad and splattering signal, complaints of malicious interference, and several other serious problems much too lengthy to cover here."

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, JULY 2, 1946 AND JUNE 11, 1960 (74 STAT. 208) SHOWING THE OWNERSHIP, MANAGEMENT AND CIRCULATION OF 73 Magazine, published monthly at Norwalk, Connecticut, for Sept. 27, 1962. 1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Wayne Green, Peterborough, New Hampshire. Editor, same as above. Managing editor, same as above. Business manager, same as above. 2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.) Amateur Radio Publishing, Inc., 1379 East 15 St., Brooklyn 30, N.Y. Wayne Green, Peterborough, N.H. 3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amounnt of bonds, mortgages, or other securities are: none. 4. Paragraphs 2 and 3 include, in cases where the stockholders or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs *show the aff. nt's full knowledge and belief as to the circumstances* and conditions under which stockholders and security holders who do not app r upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner. 5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required by the act of June 11, 1960 to be included in all statements regardless of frequency of issue.) 33,708.

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October 1960—December 1962

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AMATEUR RADIO

73

February 1963
The Usual
40¢

73 Magazine

Wayne Grein, W2NSD
Editor, etcetera

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and
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de W2NSD

never say die

AWARDS

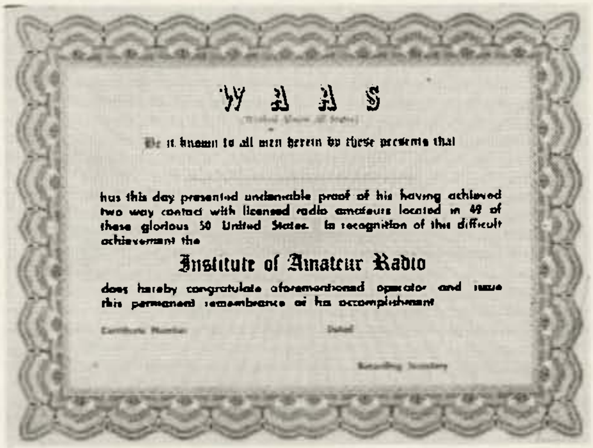
Though the awarding of certificates is a little out of the line of 73 Magazine, devoted as it is to the technical and constructional side of our hobby, and my own feeling is that there are already several times too many certificates available, still, even to a reactionary like myself, the success and popularity of the presently available awards, incredible though many of them are, is something that I can not, in my own kinky way, completely overlook when balance sheet time comes at the end of each month and, fighting off nausea, I look over the list of dollar certificates that others have made available with considerable success. (Whew!)

Operating on the assumption that any certificate is a good certificate and that certificate hunters, like DX hunters, have to get 'em all, whether they like 'em or not, I hereby present to the addicted the following awards:

The first award, sponsored by the Institute of Amateur Radio, is the CHC CERTIFICATE. The Certificate Haters Club Certificate is available to any licensed amateur radio operator who submits a signed statement that he has never been awarded any other certificates and that if, in the future, he ever is awarded another certificate that he will hate it. Please include one dollar with the application to help cover the costs of administration of this program.


Be It Known By These Presents That The
Institute of Amateur Radio
C H C

The second award certificate now available from the Institute is the WAAS CERTIFICATE. This is the Worked Almost All States Certificate and is available only to licensed amateur radio operators who have proof of contact with 49 states, but haven't been able to get that elusive 50th. There is no reason why all this effort should go unrewarded and unacknowledged for it takes almost as much effort to contact 49 states as it does 50. What a shame to get so close and then miss just for the lack of one extra state! Please include the 49 QSL's in alphabetical by state order, a note indicating the missing state and a dollar to help defray the costs of administration of this program. Stickers are available for WAAS made all on one band, all with one mode, or all in one year upon separate application with submitted cards and dollar to help defray the costs of this program. Mode stickers are available for CW, AM, SSB, and RTTY.


W A A S
Be it known to all men herein by these presents that
has this day presented undeniable proof of his having achieved two way contact with licensed radio amateurs located in 49 of these glorious 50 United States. In recognition of this difficult achievement the
Institute of Amateur Radio
does hereby congratulate aforementioned operator and issue this permanent remembrance of his accomplishment

DXDC Certificate. Sure, it is easy to work 100 countries on twenty meters, but how about forty and eighty? This award requires QSL's from ten countries. Special stickers are available for all contacts being on single bands, using a single mode of emission and all being made during any one year. This award naturally brought up the perennial question of what is a country and what is not a country, a little matter that has brought on near revolutions and frequent mass hysteria. What should we do? Should we accept the ARRL list as it is and keep on accepting new countries as they think them up? Or perhaps should we make up our own list, granting new country status here and there as either the demand requires or friendship dictates. There was a strong in-

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(W2NSD from page 2)

clination on our part to accept the ARRL system of designating offshore islands as separate countries, thus establishing such new countries as Long Island, Staten Island, Manhattan Island, Catalina Island, Vashon Island, Block Island, Martha's Vineyard, etc. This could have many beneficial results. It certainly would cut down on the expense of DXpeditions . . . how much can it cost to take a ferry over to Fire Island? And think of all the countries we would have up in the St. Lawrence River . . . WOW! Our imaginations were so staggered by the possibilities that we decided to stick with the official U.N. country list and let them decide what was a country and what wasn't.

The DXDC Certificate applications must include QSL's in proof of the contacts claimed, a list of the countries contacted, and a dollar to help defray the costs of the program. There are no stickers available for more than ten countries contacted, so please do not apply for stickers for 20, 30, etc., countries contacted. Stickers are available, on separate application, for ten countries being contacted all on one band, all contacted with a single mode of emission used by both stations (AM, CW, SSB, RTTY), or all contacted during one calendar year. Each sticker must be applied for individually with corroborative QSL's and a dollar to help cover the costs of administration of the program.

RRCC Certificate. None of this twenty or thirty minute stuff for us. If You are a Real Rag Chewer you should be able to keep it flying for at least six hours. This certificate will be awarded to amateurs who provide a signed statement to the effect that they have completed a two-station (not three or more) contact which has lasted a minimum of six hours, with no time whatsoever out for any interruptions of any kind, even for a half minute. A QSL indicating the length of the contact must accompany the statement, and the times of starting and ending the contact must be stated. Please include one dollar to help cover the administrative costs of this program.

There are a lot more on the drawing boards . . . and we are open to any suggestions that these new awards may bring in from readers. Watch for the announcement and rules for the WAZP Certificate, the WAAC Certificate, the WAP Certificate and others. We're working on some other dandies too . . . the Worked All County Seat Certificate, the Worked American Empire award for contacting all countries con-

(Turn to page 82)

TO MY FRIENDS AND FORMER CUSTOMERS IN AMATEUR RADIO AND COMMUNICATIONS FIELDS.

I am pleased to announce formation of SBE, Sideband Engineers, Inc., a new communications manufacturing company headed by myself and a fine group of former amateur radio associates. As many of you know, I retired from active electronic manufacturing several years ago and since then have been asked continually when I would return to the field. After careful study of potential new items that would meet my requirements of high value and performance, I have formed this group to bring you a new series of dynamic products. All will have outstanding "break-through" features.

Our first product is a new single-sideband transceiver which is described on the adjoining page. It is my personal feeling that this exceptional unit will soon lead the field. It is physically small, outstanding in circuitry, provides 4-band operation with selectable upper and lower sidebands, has built-in power supply. These are truly dynamic new features. There are several other new products in our laboratories that will soon go into production. These will be announced in the near future.

73

Faust Gonsett

SBE

Faust Gonsett, W6VR, Pres.

Sideband Engineers, Inc. Rancho Sante Fe, California

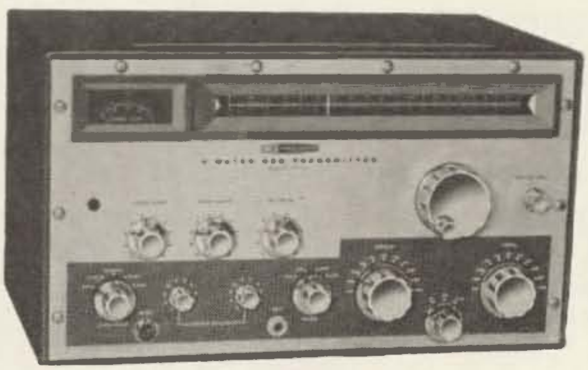
6M SSB

An examination into and some reflections upon the advantages and disadvantages of utilizing single sideband transmission on the six meter band and a brief investigation into the commercial components available for such application.

DENIZENS OF WHAT is probably our most active ham band, six meters, have lately been hearing more and more of that quack-quack-quack on the low end of their band. Will six go the way of twenty meters? Is sideband just a new snobbery for us to resist, or is it perhaps a thing to be reckoned with? Are there enough advantages to sideband to outweigh the considerable extra cost involved?

First, let's get a little perspective on the band. Six meters, though made available to us shortly after WW II, lay almost dormant for many years, mostly due to the lack of commercial equipment for the band. The few pioneers that were interested found that they had to use their own two hands if they wanted to get on six, for the few receivers or converters that covered the band were so insensitive that they were of little value and virtually none of the surplus gear hit the band. There would be a flurry of activity when the band opened up for a few hours, but the rest of the time you could listen for days without hearing even a heterodyne . . . even in New York City!

The big change came when the FCC, bowing to pressure from the ARRL and Technician licensees, opened the band to the Techs. This little rule change brought on a stampede of applications for this class of license and today we have in the neighborhood of 25,000 Technicians, with the bulk of the active Techs



Heath HX-30

Hallicrafters HA6

operating on six meters. This also brought on the instant commercialization of the band so that today we find a wide variety of gear available for six and the band is so active that it is difficult to find a place in this country so remote that you can't hear six meter stations.

Where does sideband fit in the picture? It fits here just as it did on the lower frequencies. The DX man finds that he is able to extend the range of his station considerably by changing to sideband. The increase in effective radiated power not only makes for longer ground wave reception, but increases the sock of the signal when the band is open. The rag chewer finds that QSO's are more fun when everyone is on the same channel and they are using VOX. Since sideband so far has been used by just a few of the more adventurous operators there is naturally an increase in the interest of the contacts that result.

There is one important benefit of sideband that is peculiar to the VHF bands: greatly improved aurora communications. Those of you who have experienced the peculiar transmission distortion resulting from aurora know that normally phone is completely unable to get through and CW must be used, though it sounds like a rushing noise in the receiver instead of a tone. Sideband will get through too, with the voice coming through as a whisper as a result of the multi-path reflections.

From the equipment point of view it takes quite a bit more exciter to generate an SSB

COMPARISON CHART — SIX METER SIDEBAND

Manufacturer & Model	Kit Price	Assembled Price	Final	PEP Watts	Drive	Power Supply	Notes
Telco SB-50		$85.00	6146	50	20M	Heath HP20	($29.95)
Continental SSB-6		$99.95	2E26	50	20M	HP20	
Irving Hiverter	$59.95	$99.50	6146	50	20M	HP20	
P & H 6-150		$299.95	8117's	175	20M	Included	
Hallicrafters HA6		$349.50	5894	120	10M	$99.50	Includes rec. conv.
Collins 62S-1		$895.00		160	20M	Included	6&2M, incl. conv.
L-W Labs		$100 ±	6146	50	xtal	HP20	Complete exciter
Supreme SSB-6	$180 ±	$229 ±	6146	50	xtal	HP20	Complete exciter
Supreme SSB-6VFO		$279 ±	6146	50	VFO	HP20	Complete exciter
Heath HX-30	$189.95		6360	10	VFO	Included	Complete exciter
Telco SSB-50		$250 ±	6146	50	VXO	HP20	Complete exciter
Clegg Venus		$450 ±	6883	85	VFO	Included	Complete transceiver
Heath HA-20 Linear	$99.95		6146's	125	HX30	Included	Linear amplifier
J & D Labs Linear		$199.95	7034	1000	5 watts	$119.95	Linear amplifier
Johnson 6N2 Thunderbolt		$549.50	7034's	1200	6W	Included	Linear amplifier

signal, but once you have it the amplification is a lot simpler and less expensive than high power AM. Since the great bulk of six meter ops are Technicians it is not likely that many of them will have a sideband exciter sitting around. This not too difficult to figure out fact probably has been responsible for the recent announcement of some complete sideband transmitters for six meters in addition to the earlier advertised converters which change a 20 meter sideband signal to six meter output.

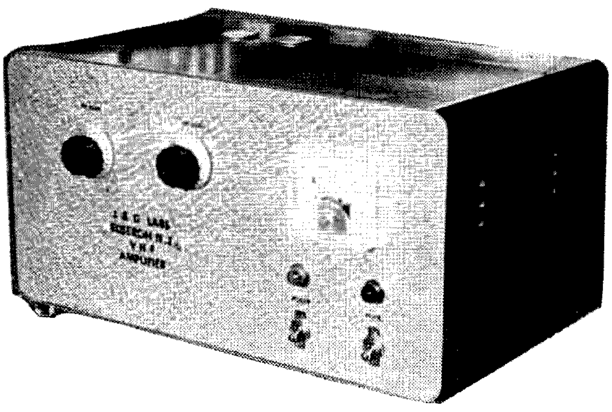
There is much to be said for either system. Older sideband exciters are not very expensive these days . . . many of them are sitting up on dusty shelves, displaced by newer equipment, and a bit of asking around is likely to uncover at least one of these that is quite reasonably priced. Even an old Central 10A

P & H 6-150

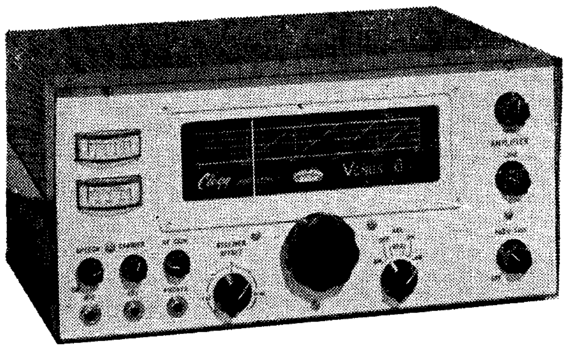
will do the job just fine. The complete sideband six meter exciter way of doing things does generally cost more, but you don't have to fuss around with a lot of separate units, power supplies, and controls. It will no doubt have a higher resale value if you consider such matters.

Perhaps you have heard the quack-quack of sideband on your six meter transceiver and wondered whether there was any way to receive this since you don't have a BFO built in. Yes, if you have an all-band station receiver around . . . and you certainly should have. You can tune into the *if* of the transceiver and use the receiver BFO for demodulating the sideband. The Clegg first *if* is at 10.7 mc so you can tune to 10.7 mc on the receiver and run a short piece of wire from the receiver antenna terminal up and stick it in the top of the first *if* can in the Clegg. This should give you plenty of pickup and you should hear the Clegg coming through the station receiver. On other equipments you can check the manual and see what the *if* is and tune it in the same way.

We've run test articles on the Continental sideband converter (November 73, p. 18) and the Irving Hiverter (December 73, p. 12). Both of these were tested here at HQ and worked out fine. They require a separate power supply (Heath HP20), and a sideband exciter with 20 meter output. The Telco SB-50, which is quite similar, has not been reviewed since Telco is about to release a complete sideband six meter transmitter. We've heard nothing but good about the SB-50 though. The

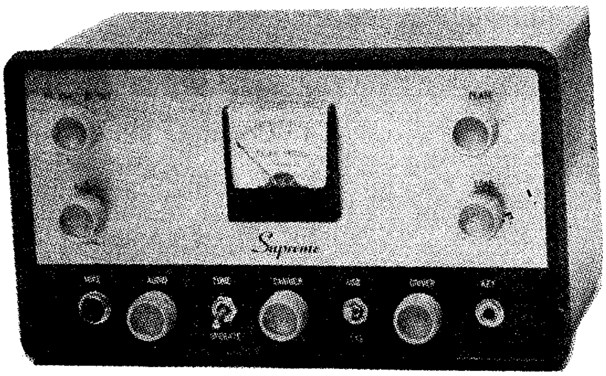


J & D Labs Linear

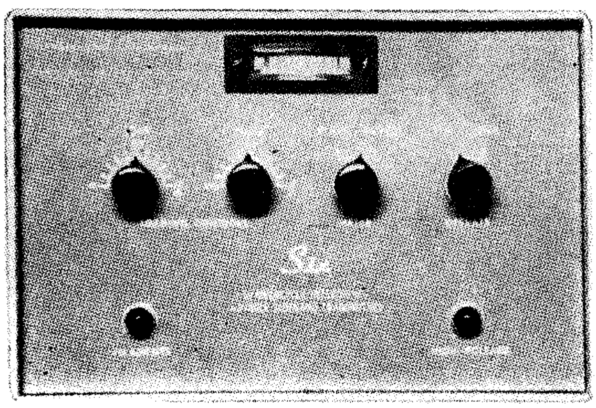


Clegg Venus

Irving Hiverter



Supreme SSB-6



Continental SSB-6

P & H Model 6-150 transmitting converter does much the same as the others, but has a built in power supply and linear which runs considerably higher power (175 watts PEP). The Hallicrafters HA-6 gives 120 watts PEP and converts from ten meters instead of 20. This unit also contains a nuvister converter which brings the received signal down to ten meters for use with any of the popular transceivers that cover ten meters and have an output of from 10 to 100 watts.

The Collins 62S-1 is designed to convert the signal of the S-line or KWM-2 up to both six and two meters, giving 160 watts PEP input. It also has a converter to bring the signals back down to the transceiver or station receiver.

One of the most interesting new rigs for the Tech is the Supreme SSB transmitter. This rig runs 75 watts PEP and doesn't require the usual low band sideband exciter, being a complete transmitter in itself. A separate power supply is required for this rig and almost full power can be run with the usual Heath HP20 supply. The Supreme SSB-6 operates from a crystal or from an external 5 mc VFO.

Another sideband exciter which will be on the market soon is from L-W Labs. This crystal controlled rig will have the usual 6146 final with about 50 watts PEP input, be very small, and sell in the neighborhood of $100 less power supply! Clegg has recently announced the imminence of a six meter sideband transceiver which will cost about $450, run about 85 watts PEP, and have a built in stable VFO.

Heath has recently announced their HX-30 six meter sideband exciter kit which has a built in power supply, VFO, VOX, etc. The power input is 10 watts PEP. They have a linear available for this, the HA-20, which boosts it up to 125 watts PEP with a built in power supply.

Since linears have been mentioned, it is only fair to point out the J & D Labs linear which runs 1000 watts input PEP on six or two meters to a 7034. They have a power supply available if you are short on 2000 volt sources. Needs only five watts drive, so any of the transmitting converters or exciters will drive it quite adequately on SSB. The Johnson 6N2 Thunderbolt covers both six and two meters, uses two 7034's requires only 5-6 watts drive, and runs 1200 Watts input PEP with built in power supply.

The Future?

The many advantages of sideband over AM for six meters should eventually make that mode even more popular that it has become

on the lower frequencies. I expect sideband to slowly creep up from the low end of the band until most of the active segment of six is quack-quacking. We'll probably always hear a few remnants of the low powered transceivers here and there, mostly toward the hjgh end of the band.

It seems logical that once the conversion is made to sideband that a great many operators will want to increase their ground wave coverage even more and we will see more and more linears on the market. We shall see . . . maybe I'm wrong and all we will see are more AM transceivers.

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432 mc Gallon

The increasing of the legal power input for the 432 mc amateur band to one kilowatt in most sections of the country, effective in January, means that TV and other experimenters using this band will be wanting to build a little amplifier for their present rigs. K2TKN here gives us the details on such an amplifier. Note that he does not use old fashioned construction techniques and thus does not suffer old fashioned losses of efficiency. We assume that the constructor of this unit will have been around 432 enough so he doesn't have to have detailed drawings and layouts in order to reproduce the rig.

Bill Ashby K2TKN
Box 97
Pluckemin, N. J.

MOST VHF POWER amplifier design has been a natural extrapolation from low frequency circuits. This has lead to some rather fixed views by many as to the relative merits of various designs—but the writer has found that D.C. band circuits and techniques usually result in very inefficient VHF devices. In recent years, a number of VHF tubes have been produced that are within reach of the serious amateur. These allow design of VHF amplifiers that use some rather new concepts and give excellent efficiency. One of the better examples of this break-thru in tube design is the RCA-7650. The ceramic construction allows high-temperature, efficient operation thru 1296 mc. The original cost is high, but the rugged construction and ratings indicate long years of operation, so that cost per year should be within reason.

First, you have to make up your mind that it is going to be necessary to build the socket for this tube. These VHF tubes that have their elements brought out in a series of graduated diameter rings keep this job from being too difficult, but necessary. After getting over this mental block you will be prepared for the rest of the good news, that is you are going to build all the other components too, if reasonable efficiency is to be expected. At 432 mc, this does not come out too badly—the normal assortment of hand tools, a drill-press and several gallons of elbow-grease will overcome the mechanical details.

This amplifier is grounded-grid with a shorted half-wave cathode circuit and a high efficiency half-wave plate tank. The grid is bypassed to ground on the cathode side of the socket partition and the screen is bypassed to ground on the side of the socket partition toward the plate circuit.

I have hated grounded-grid amplifiers with a vengence for years, for they usually would work half-heartedly only after much coaxing. In the usual configuration, the cathode to grid circuit acts like a high impedance diode with low plate current and drive, and a very low Z, high current rectifier with high drive and plate current. All in all, a very peculiar device. Working with 2C39's at 1296, I found a circuit for the cathodes that reduces this problem to a minimum. By placing the cathode at one end of a half-wave line and grounding the other end, the cathode is forced to operate in the fundamental high current mode even with no plate current or voltage applied to the tube. The cathode circuit cannot jump up to a highly reactive reactive impedance and cause instability at any condition of the plate circuit, which is a welcome change! The drive, output of a 4 X 150 operating straight thru, is tapped up on the cathode line a short way from the grounded end, at a point that gives a reasonable match under operating conditions. The ½ wave line is tuned to 432 mc at the center with the smallest Johnson variable available. This could well be a 1-10 mmfd glass piston

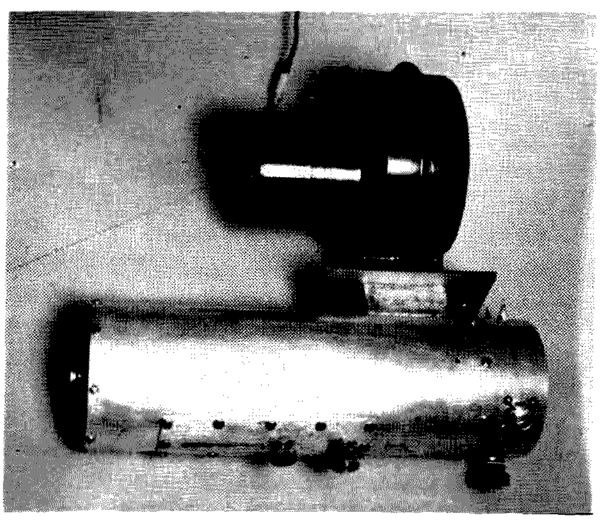
trimmer, instead.

Other than a series 100 ohm carbon resistor to discourage H.F. parasitics, the grid and screen are operated by the book.

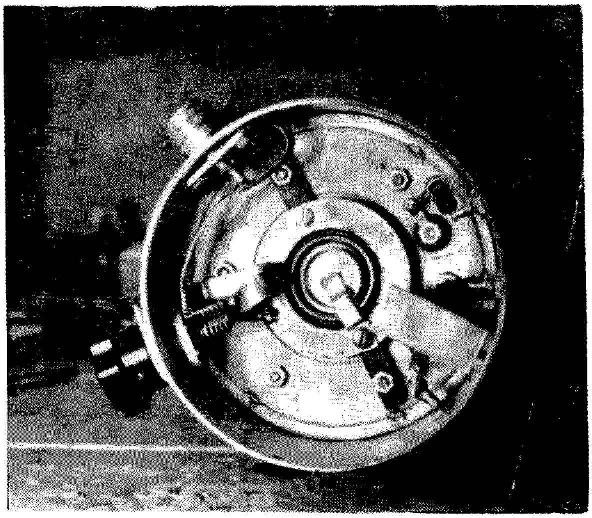
The plate circuit is a ½ wavelength of 2 1/16 inch dia. thin walled copper tubing that matches the diameter of the 7650 plate. After several years of work at 1296 mc, I have slowly realized that any high-power resonant circuit that requires a bypass capacitor at a high-current point is going to be inefficient. A ¼ or ¾ wave plate circuit that utilizes a high capacity mica, mylar, teflon, or you name it dielectric capacitor that must isolate the HV and bypass very high rf current, is going to have a poor rf power factor. This loss shows up as heat and causes a deterioration of the dielectric that can be fairly spectacular. This also appears to be where the 20 to 40 percent tank circuit losses, shown at these frequencies on all commercial data sheets, comes into effect. Lack of necessity to bypass the plate tank is very likely why most old-timey circuits for 2 meters that worked well at all were push-pull!

But while an efficient, low loss bypass capacitor for high-current operation is practically impossible to come by, a dead short for rf that will carry almost any practical amount of rf current is simply another quarter wave of tank circuit. Most attempts in the past by Amateurs to use ½ wave plate lines in single-ended amplifiers have ended up pretty bad. But how do you expect a tank circuit, 4 inch OD with a 2 inch center conductor, with a Q of several thousand to act when some idiot tries to tune it with a surplus neutralizing capacitor or worse, with a penny on the end of an 8-32 screw!

In this amplifier the ½ wave plate tank is naturally resonant when installed normally on the 7650 tube at approximately 450 mc. Then



432 mc KW amplifier



Cathode-end of amplifier

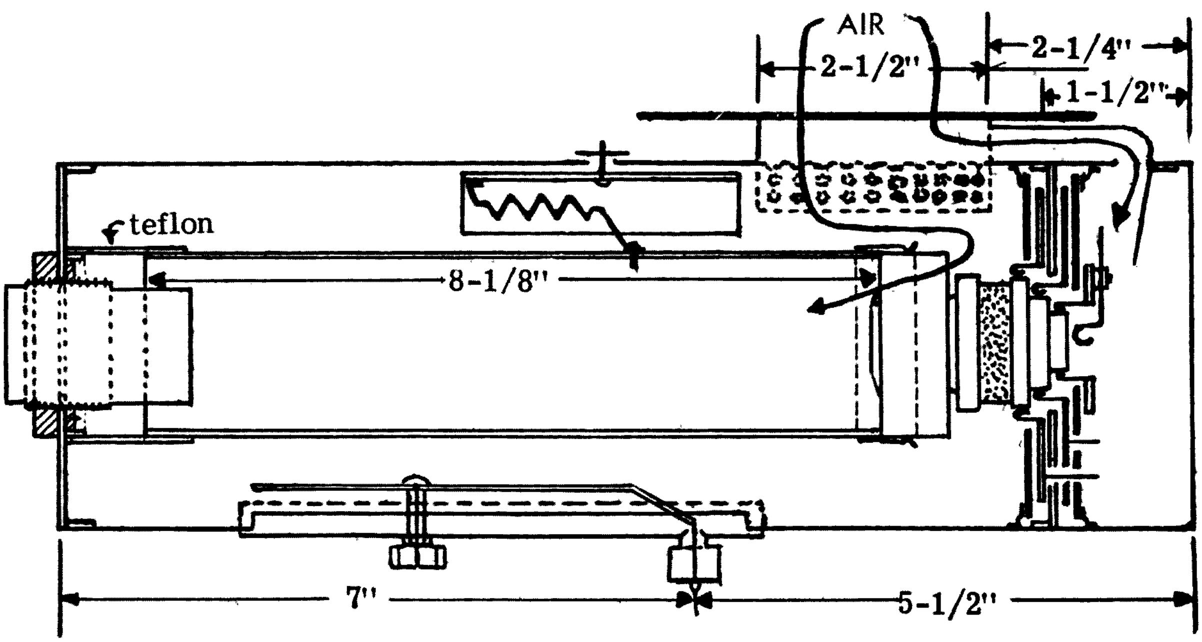
it is trimmed lower in frequency by means of the threaded 1½ inch OD air exhaust tube. This is in close proximity to the free end of the plate line, and forms a trimmer capacitor that is able to carry the full circulating tank current with low losses, and cannot possibly be self-resonant at the operating frequency. The large area of conducting surface of the inner conductor and outer shell of the entire plate circuit so distribute the rf current that silver plating becomes a luxury. HV is bypassed to the wall of the plate cavity by a brass plate 3 inches square which is insulated by teflon sheet. An rf choke connects the dead spot on the inner conductor to the bypass for HV.

The antenna coupling circuit took a while to straighten out. Handling over 600 watts of 432 mc power can get a little sticky, even at 50 ohms. The slotted bar type of semi-fixed coupling loop works fine and allows adaquate variation. To co-ax fitting is a teflon male type N to match the antenna transfer device. A 50 ohm load must be connected during any power operation or this fitting will go up in smoke.

Air is provided by a blower rated at 100 c.f.m. in free air. The 7650 has over one-half inch of back pressure thru the plate, and a blower of this size is needed to supply enough air at this pressure. A small amount of air is bypassed around the socket partition to cool the cathode. Do not attempt even short periods of operation of the filament without air flow, for solder melts on the cathode surface in less than one minute. Air flows into the main plate cavity thru the tube and out the plate line thru the trimmer pipe.

Construction

The main cavity tube is brass, 4 inch OD by 12½ inches long. The wall is just over 1/16" thick and it is silver-plated, having been salvaged from a surplus wave-meter. The plate end cap and the socket partition are of 1/16" brass plate, cut to the proper diameter and soldered to short rings of the 4 inch pipe that were cut and formed down to make a sliding inside fit. The blower mounting is formed from 1/16" brass and soldered to the main cavity. The pipe that carries air to the cathode is square channel formed from brass and soldered in place. Rather than cut a hole in the main cavity for air intake, the proper area is drilled with many ⅜ inch holes. These allow free passage of air but do not lower the Q of the cavity as a large hole would. The HV bypass is made of a 3 inch square of a scrap of the main cavity



material. The plate is secured and the HV brought out by a 10-32 bolt thru a ¾ inch hole and teflon insulation. A short length of ¼ inch tubing is soldered inside this plate so that an appropriate jack on the end of the rf choke plugs in when the plate line is installed. The plate circuit tuner and air exhaust tube is 1½ inch diameter with a fine thread cut over a portion of the outer wall—salvaged along with a thick nut that was hack-sawed into two thin ones, one soldered to the end plate, and the other acts as a lock-nut after tuning is completed. The teflon tubing that supports the plate line at the trimmer end was fabricated out of a 1/16" thick flat piece lapped over ⅜ inch and sewn with a needle and cotton thread by hand. It is a force-fit over the plate line and a sliding fit over a ¼ inch length of 2 1/16 inch tubing soldered inside the end cap. The plate line is held in good thermal and rf contact with the 7650 plate cooler by a strip of very stiff finger-stock that is soldered to the end of the line. Use of regular soft-solder here and in fabrication of the socket as a safety measure, for it will soften and let go before the tube temperature gets dangerous, yet allows normal operation.

Close overload protection in all element power supplies is cheap insurance when using hard-to-get tubes.

The output coupling circuit cover plate is made of another scrap of the 4 inch tubing, 5½ by 2 inches. A square hole, 5 by 1½ inches is cut in the wall of the main cavity with holes drilled and tapped around the edge to secure the plate. A 3 inch slot, wide enough to pass an 8-32 screw is drilled and filed for the sliding short. A similar slot is sweated out of a brass plate, ¾ by 5 inches—1/16" thick—one end of which bent and tapered down to form a smooth junction where it connects to the center conductor of the rf connector. This male type N fitting is soldered thru at the proper place in the coupling cover.

Socket Construction

Full size templates and exact dimensions of each piece of material are not of much value unless a precision machine shop is available. A very efficient, if not pretty, set of bypasses can be made by any experienced ham if common sense and plenty of patience is available. The finger-stock is Instrument Specialty, as specified in RCA's 7650 tube data sheets. This material could be scrounged from surplus, I am sure, but some fresh new strips will make you feel better, if poorer. All other material used is 1/16 inch brass plate and the thinnest teflon sheet you can obtain. Starting at the shield partition, going toward the plate circuit,

Various sub-assemblies

there is a 3½" disk of teflon, then a 3¼" disk of brass, then another 3½" circle of teflon, and finally another brass disk that is 3½" OD. This top plate has a hole in the center large enough to clear the screen and its fingerstock that is soldered to the middle brass plate. In other words, the 3¼" disk has a hole cut in it's center just large enough to slide over the finger-stock that contacts the screen and is soldered to this finger-stock. It is insulated from the partition and the grounded cover disk by disks of teflon. The complete bypass assembly is secured by six 6-32 bolts around the edge. These bolts contact all grounded disks and the holes in the partition are threaded so these thru-bolts make good contact. These holes in the screen and grid disk are enlarged to ⅜" to provide clearance. Filling of these ⅜" holes with hand-made teflon washers 1/16 thick will make assembly much easier. A 6-32 bolt soldered to the screen disk brings the screen voltage thru ⅜" holes in the partition plate and all other parts of the bypass. The grid finger-stock and bypass is made in exactly the same manner on the cathode side of the partition. The same bolts secure it as the screen assembly. Another 6-32 bolt is brought out in a manner similar to the screen to supply grid bias. The finger-stock that contacts the cathode ring is soldered to a disk of brass that is 2" in dia. This is supported above the grid bypass on two squares of formica. Two very short 4-40 screws secure the cathode disk to these insulators. They are held by two of the thru-bolts. Filament power is brought in thru a ¼ inch strip of spring brass insulated by teflon.

Use of the grounded disks over each rf bypass disk are well worth the extra effort. After final assembly, the edges of these outer disks are soldered to the partition in six spots using a very hot large soldering iron. This latter refinement might not be necessary on 432, but was helpful on 1296. Before final put-together, wash and dry all parts carefully, then assemble well away from the construction area, for a single filing of silver or brass between the plates means complete dis-assembly and rebuild. After completion, this makes a rugged, extremely efficient UHF socket.

Cathode Circuit

Locate two holes ⅜" from the edge of the main cavity, 2¾" from each other. Mount a type N fitting in one, and the cathode tuning capacitor in the other. Solder a 3¼" by ¼" strip of flashing copper to the capacitor stator and bring straight over and solder to center conductor of type N then form half circle and secure under one of the mounting screws of the rf fitting. Form a 2½" by ¼" strip of the same material into a single turn coil and solder to stator of capacitor and the other end to the cathode disk at a point nearest the capacitor. A 10 turn, ¼" dia., #18 wire, rf choke is soldered to the filament contact strip and brought out thru the wall of the cavity by means of a feed-thru capacitor. The screen and grid ring studs go to 100 ohm 2 watt carbon resistors and out thru feed-thru capacitors. The feed-thru for the screen must be rated for 1000 volts.

Operation

Power supplies are necessarily interlocked and time-sequenced, and overload protection is furnished for both plate and screen. One-half second delay after antenna transfer is completed is mandatory before HV comes on, and HV is removed one second before antenna can be transferred back to rcvr. It happens that the power supplies used for this amplifier are variable from zero up, so that a variety of operating conditions have been tried. I have yet to find a really accurate means of measuring large amounts of power at these frequencies. Every serious 432 nut that I know of has a 4X150 running straight thru, so there is no drive problem with this amplifier. I have found, as always, higher plate voltages result in more actual power out for a given input. With just under 3 KV on the plate at 350 mils, loaded heavily (abt 420 volts on screen to control input) for max rf out—there is more than 600 watts heading for the antenna. If this rf affects receivers the way it does rf line and hardware, I am going to have some fun. Every dummy load and half the feedline, relays, etc., have gone up in smoke during the few short hours of operation since this beast got up to full power.

Conclusion

The number one deterrent to reasonable results by a state-of-the-art 432 mc station is the extremely narrow patterns of even modest sized arrays at this frequency. With 10 degree beamwidth patterns, it is necessary to make schedules to even call CQ when you have low power. With modern tubes, such as the RCA 7650, high power can be efficiently generated, and you can talk a long way off the back or sides of your beam with this power—and if someone happens to be in front—that is his problem! This kind of a signal can be heard way off the peak of the beam! The next time WWV is sending W-4 or worse, listen with the beam somewhere toward North, for I will be illuminating the whole curtain with 432.000 mc pwr. After you have peaked your beam, I might even be able to hear your low power—build this rig and we won't have to wait for aurora!

. . . K2TKN

Book Reviews

USING THE SLIDE RULE IN ELECTRONIC TECHNOLOGY, a RIDER (#253) book by Charles Alvarez is an excellent text for the engineer, radio amateur or technician who wants to learn to solve problems rapidly. It examines the application of the different scales of the slide rule to typical problems. Practice problems with answers are included. Soft-cover, 109 pages, $2.50.

Are you wondering how to interpret schematic diagrams or trace a signal path through a complex circuit? **HOW TO READ SCHEMATIC DIAGRAMS** by Donald Herrington, a HOWARD SAMS publication will help answer these questions. It describes and illustrates various components and their schematic symbols. This book shows the step by step procedure for tracing a signal through a typical circuit. Soft-cover, 128 pages, $1.50.

Alan Lytel has written a **TRANSISTOR CIRCUIT MANUAL** (HOWARD SAMS TCM-1) which is a collection of the current applications of semiconductors. It includes a general discussion of each type of application and then a specific circuit giving the component values. This book would be a valuable addition to the library of anyone interested in transistors. Soft-cover, 255 pages, $4.95.

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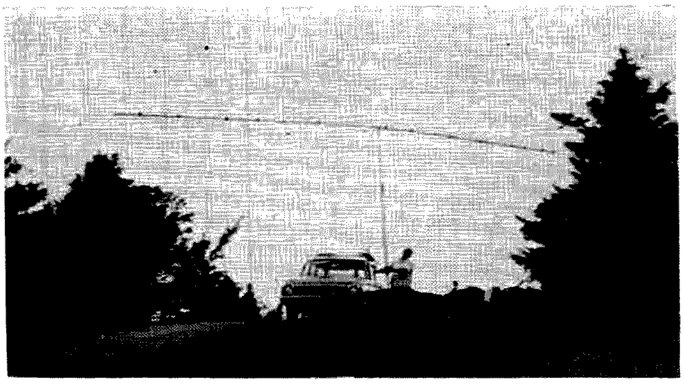


Mountain-Topping for **BLOOD**

or How to Work 49 W2's (and a couple of 3's) in One Evening, on 2 Meter Phone from the State of Maine

A DETAILED list of the 6 "MUST" items follows. *If* you *do* operate with *all* of them we guarantee that *you too* can fill pages of your log in *one day*, with nothing but stations *over 200 miles!* On 2 meter phone!

No. 1

A good transmitter of some power. After many years (first call 2BAV, Rye, N. Y., 1923) of more or less "amateur" hill-topping on 5, 2½, then 2, ending with a Gonset III which is still a great rig for my money, I decided to shoot-the-works. More or less careful calculations, and many talks with good 2 meter stations led to the purchase of a Johnson 6 & 2; an Eico modulator, 50 watts; and the Heath-Kit 600 volt power supply; as written up in 73, November 1960. I have never had a moment of regret. Input has been kept at 90 watts to avoid buying another 5894, and the 3 units mounted in a carrying rack as shown in the pix. Don't forget that this type of operation calls for the complete station *in your car.*

An important part of the rig is an ac generator. Keeping away from "bargains," I chose a Sears-Roebuck 750 watt ac job. This weighs some 80 lbs., but with two baby-buggy wheels and the "antenna plank," it goes in and out of the Falcon wagon with ease. (By the way, *don't* do serious mountain topping without a stick-shift). Some 100 feet of ac cable keeps the somewhat noisy putt-putt away from the car on mountain locations, and, *very important*, allows it to be trundled down into the bushes where it does not bother the many sight-seers who may be found up there during the day. Rangers and wardens take a dim view of complaints of noise. At night there is a different class on hand who are not so fussy!

No. 2

A good receiver. This means selectivity and a low noise figure. Calibration must be fair to good also, as you will always hear, "please look for my friend WA2 so & so across town. He has never worked Maine yet. He is on 145.426!" Having a Morrow 13 tube amateur band receiver with 6 tuned circuits on 200 kc settled the tunable *if* portion of the unit. An Ameco xtal converter with added Nuvistor pre-amp takes care of front end requirements for now. These units, with power supply, are also mounted in a carrying rack. This "carrying" business is strictly limited to in and out of the car, piece by piece. The entire set-up cannot be moved any distance out of the car, short of by some half dozen *young* amateurs.

No. 3

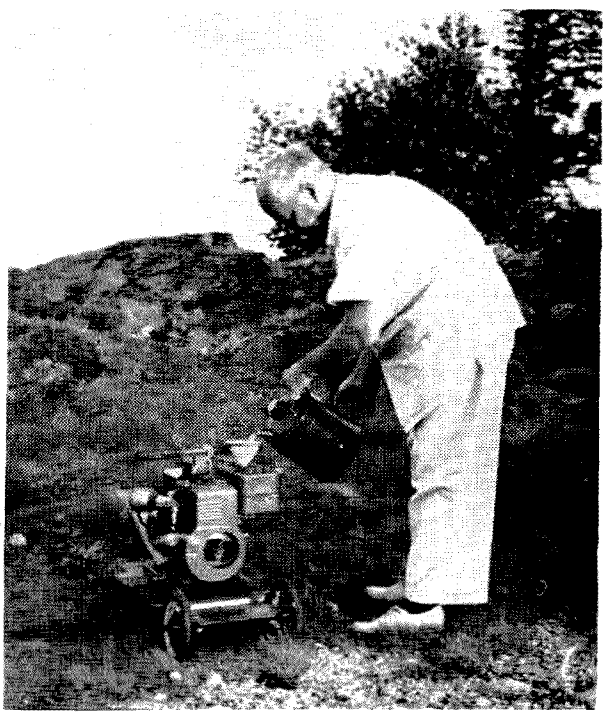
A *powerful* beam. This means as near to 20 db gain as possible. It does *not* mean stacked halos, home-made 3 elements, etc. I will admit, being an "antenna man" has its advantages here, but this item of portable beams will be taken up soon. I used a 24 ft. Yagi (2 twelve foot sections) wide-spaced, high gain, up to 2 years ago, at which time a 36 footer was tuned up (more of that further down the log). This is in three twelve foot sections, with a clip-on top guy of poly-propalene (transparent to radio waves) "Float-Rope," and weighs less than 10 lbs. The gain is somewhere between

17 and 19 db. This *actually* means that *both received and transmitted* energy are amplified some 60 to 70 times, over operation with a tuned ½ wave dipole. Don't forget though, GAIN IS EQUAL TO DIRECTIVITY! The fact remains that when you are in Maine and you *do* point it on New York, your 90 watt signal there is the same as though you were using a 6 kw transmitter and a dipole. There are other advantages too, concerning ground effects (Again, further down the log).

The mount and rotator used for the beam is shown also, although it is not too good in a high wind. At least 2" masting should be used to counter the 36 ft. torque. Care should be taken with all small db items as regards rf. Don't let anyone sway you with "that's only ½ db and you can't *see* that!" These *all add up*, and when a TWO-ER (Benton Harbor 1 watter) is trying to get his call through to you from Hoboken, N. J. with a busted coat-hanger antenna indoors (he did, too!) you'll be sorry! Examples, 36 footer instead of 24; 15 feet of mast instead of car top; Times Wire & Cable coax., T-4-50 (½ db less attenuation than RG-8/U); operation on favorable edge of mountain top instead of back from the edge (more on this drop-off later); *if*'s all peaked; power indicator on transmitter; and, well, you get the point.

No. 4

Elevation. Again, we don't mean 2 or 3 hundred feet. Let the West Coast boys snicker, but we have to do with what we have, so here goes. In Maine, the top of Mt. Agementicus is only 692 ft. above sea level but



it sticks up all by itself above the New Hampshire and Maine coastal flats, with a lot of the highly desirable drop-off. This does marvelous things on DX for a vertically sharp beam.

In New Hampshire, Mt. Pack Monadnock is 2280 ft., and in Vermont Mt. Equinox is 3800 ft. above sea level. Note that these are all *drive-ups*, remember the 6 man team? From any one of these, using 5 of the six "MUSTS" (leave out No. 5 "small band openings") good QSO's can be had with Charlie W3IBH in Philadelphia, Pa., on a flat band. This is some 300 to 350 miles *airline*. (And no QRM)!

No. 5

Medium to Small Band Opening, A "flat" band will in general let only the 300 watters or elevated W2's through to Maine, even with all of the other 4 previous items on hand.

A real, "wide" opening will clutter up the band too much, with W4's in there shouting, etc. What is needed for pages of continuous W2's in the log is a sort of "limited type" of opening.

This condition can be predicted with reasonable success by following the high pressure areas over the region, in a newspaper which shows them (N. Y. Tribune, Times, etc.). The *trailing* edge brings good conditions, in the summer time. The isobars (equal pressure lines) must however, run *parallel* with the desired path.

No. 6

A Hard-Hearted Operator. Under no conditions must a call from a WI be answered! This would immediately break up the string of W2's going into the log! They will wait in line to work Maine, but *not* if you "waste your time" with "locals!" This leads to plenty of "misunderstandings" (a slight understatement) in WI land, but, as they say Down East, "You can't make an omelette without breaking eggs!" Getting down to the facts of life, some "little guy" (one who does *not* have any of the 6 items listed) will be listening with a Communicator II, a 5 element beam on the roof of his "Ranch," down on the flats in some river valley (an awful lot of new homes are built on this kind of land. The old Indians wouldn't even live there!) All of a sudden he hears Maine coming through nice and loud! WOW-EE, he starts calling, no answer. He listens to the deal and hears the Maine station coming back to Gonsets on Long Island. Of all things! "He *must* be hearing me!" (You're right, I did!) But, what can you do? You didn't build all those racks, cables, masts, planks, beams, etc., put them all in the car, drive an hour and a half, set them all up on a mountain top, (you even have to *locate* these drive-up mountains by trial and error over *years*) sit cramped up in the car for eight hours fighting off all kinds of ravenous flying mountain-top bugs, and then pack the stuff in the car at 2:00 A.M. and drive home again, *just to work WI's!*

Also, many operators are born rag chewers, local operators, etc. They *like* long QSO's! They just *cannot* understand the 1½ minute contact limited to antenna, power, & signal. Occasionally I relax and have a long QSO. Once even for over an hour but *this* was talking about coming 1296 mc work. So, on reading these notes maybe some of the W1's will understand the Hard-Hearted Operator deal.

That ends the list of items. The log for one of those evenings, Mt. Agementicus, near York, Maine, August 4th, 1961 follows.

I started at 9 o'clock (P.M.) at the low end of the band. You will see how long it took to get up to WA territory. 9:00 P.M.

W2DHB; 9:22 K2ATA; 9:32 W2IZA; 9:35 W2NCF; 9:45 K2RTH; 9:55 K2LCU/2; 10:00 K2LIO; 10:05 K1NPE (Norwalk, Conn. is very near W2 land!); 10:10 K2BNK; 10:12 W1IBU (I must have been getting soft-hearted!); 10:15 W2CDO; 10:21 W2IGX; 10:33 K2UAF; 10:35 W2WIY; 10:40 W2UVU/2; 10:45 W2LJF; 10:50 W2COT; 10:55 W2YPM; 11:05 W2BAH/2; 11:10 W1JZA (Conn.); 11:15 W3DJJ; 11:20 W3LHF; 11:21 K2SJN; 11:25 WA2HFI; 11:26 (real short contacts!) WA2NMX; 11:30 K1RBS; 11:31 K1IED; 11:35 WA2FBA; 11:43 WA2DRK; 11:45 WA2GRE; 11:50 WA2QEG, (you can see that by now I had gotten up into the technicians band!); 12:01 WA2OLC; 12:08 WA2NUQ; 12:10 WA2MDT; 12:14 W2EEW; 12:22 WA2DPN; 12:25 W2AMQ; 12:30 WA2CIIN; 12:35 WA2OSY; 12:40 WA2MOY; 12:45 WA2HVV; 12:46 K2HHS; 12:50 W2IMG; 12:52 K1GSD; 12:53 K2RRZ; 12:54 WA2LPJ; 1:00 W2QCR; 1:02 K1DDY; 1:04 K1DIII (see what happens when you answer a W1 call!); 1:05 WA2NOF; 1.07 K1NUM; 1:09 K2KME; (must be back at the low end again); 1:12 K1NMO; 1:15 K2EAF; 1:20 W2JJI; 1:22 W3SFY; 1:50 W2AMJ; 2:00 K2DDE; 2:02 K2KRJ; 2:21 W1UVZ; 2:25 K2ORA; 2:29 WA2BAH; 2:35 WV2SPG.

So then I packed up antenna, putt-putt, mast, etc., and drove home. . . . K1CLL

Simplified 8JK Beams

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ONE OF THE SIMPLEST directive antenna arrays for 7 through 50 mc is the "flat-top," or 8JK beam. Since 1945 several versions of the 8JK have been employed at W6WAW with exceedingly good results, especially in DX work. The antenna is characterized by a bi-directional gain falling between 4 and 6 db, plus the fact that it produces the low-angle of radiation required to obtain maximum skip on multi-hop DX, even at fairly low heights above ground (approximately one-half wavelength).

The original 8JK design employing two single wire dipoles fed 180° out-of-phase was somewhat difficult to match properly, due to the low impedance viewed at the feed point. However, the famiiar "twinplex" configuration, employing a 3-wire folded dipole effectively raised the center impedance to around 275 ohms, providing a fairly good match to a 300-ohm twinlead phasing section and transmission line. This antenna is a bit cumbersome how-

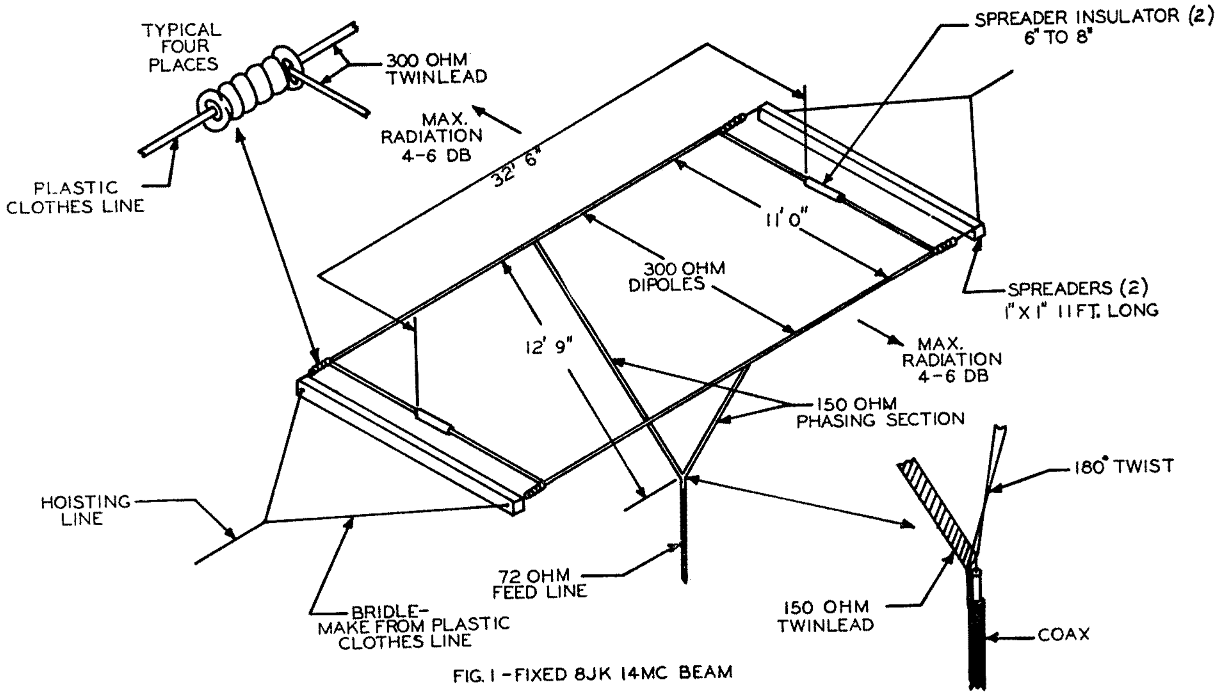
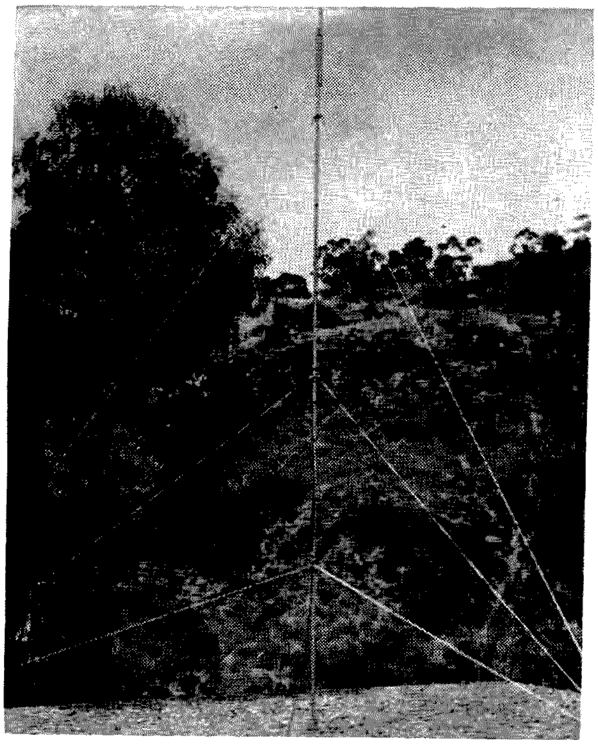


FIG. 1 -FIXED 8JK 14MC BEAM



ever when cut for 7 or 14 mc. A simpler configuration is to make the folded dipoles from 300-ohm twinlead. This produces a center impedance of approximately 150 ohms, in turn permitting the phasing sections to be cut from 150-ohm twinlead.

This all twinlead version may then be fed with a 72-ohm transmission line. Tests at W6WAW have shown little difference between feeding with 72-ohm twinlead, or using a 72-ohm coaxial line. However, it is simpler to match the coaxial line to the pi-network output of most transmitters.

The 8JK antenna can be shortened approximately 30% by folding the ends inward without degrading performance of the array. This permits erection of an antenna for 14 mc having a horizontal space requirement of 26 by 11 feet. At this size an 8JK is very easily constructed as a rotable array, requiring a maximum of 13 feet turning radius. As the antenna is bi-directional this also permits use of a simple method of rotation, as only 180° is required.

Construction of both a fixed, and a rotary version of the 8JK are covered in the following details. The antenna measurements are given for 14 mc operation, however if it is desired to build the antenna for any other frequency between 7 and 50 mc, the proper dimensions may be found in Table 1.

Fixed Array

First cut two dipoles from 300-ohm twinlead. These should be 32′ 6″ in length, with

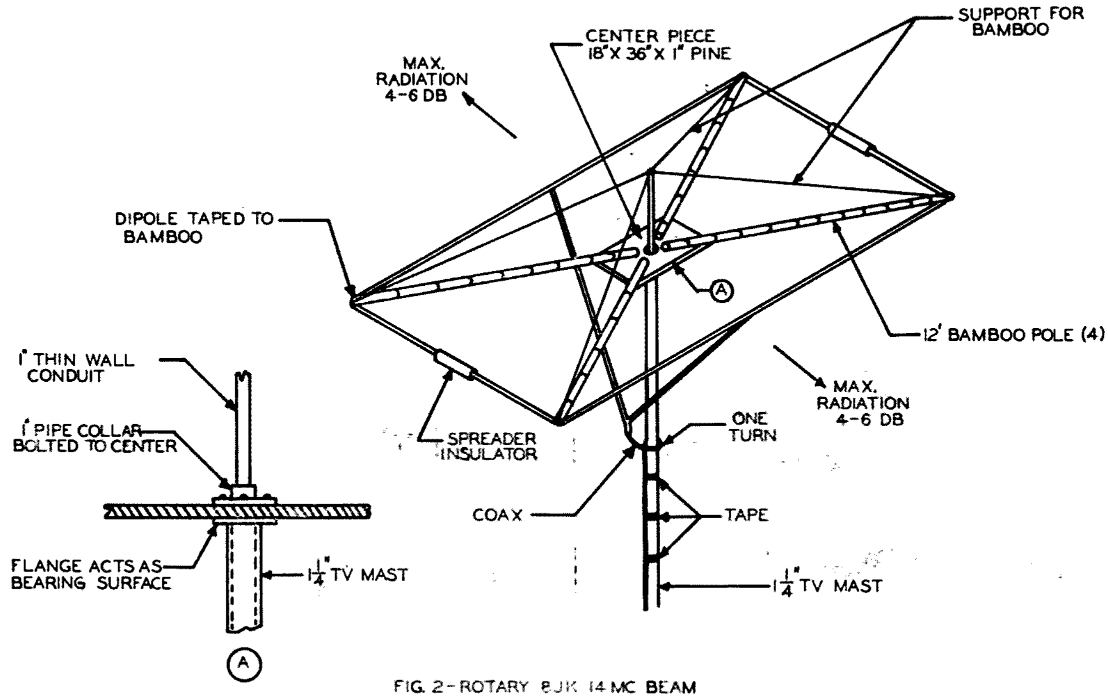


FIG. 2—ROTARY 8JK 14 MC BEAM

about 6 to 8 inches of excess wire left on each end. Next, cut the two phasing sections from 150-ohm twinlead. These should be 12' 9" in length. Open one side on each of the dipoles at the exact center and connect the phasing sections. These connections should be soldered, and some surplus insulation melted around the joint for protection.

Twist one of the phasing sections 180° with regard to the other as shown in Fig. 1 and connect the free ends of the two phasing sections together. Connect the 72-ohm transmission line (twinlead or coax) between this junction and solder. Wrap this connection well with tape to prevent entrance of moisture, which will damage the coax.

The next step is to construct the spreader arms and antenna bridle as shown in Fig. 1. Attach a glass or ceramic insulator to each end of the two 11 foot spreaders. An easy way to do this is to drill a hole through each end of the spreader. Pass the end of the bridle line through the hole and secure to the insulator. Measure off sufficient line for the complete bridle and connect the other insulator in the same manner. Fabricate the second spreader the same way.

Insert one end of a folded dipole section through the remaining eye on each of the four insulators. Twist the two wires together at each end of the folded dipoles and connect the spreader insulators at each end as shown in Fig. 1. As the rf voltage at the end of each dipole section is quite high the spreader insulators should be at least 6 inches in length.

Attach a hoisting line to the apex of each bridle and raise the antenna into position. For best results the array should be at least 35 to 40 feet above ground for operation at 14 mc.

TABLE I

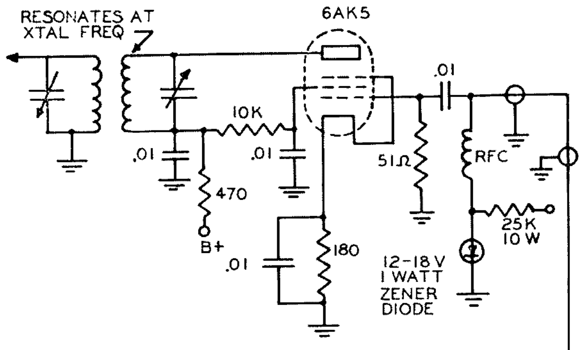
FREQUENCY	LENGTH OF DIPOLE	LENGTH OF PHASING SECTION	DISTANCE BETWEEN DIPOLES
7.0	66' 9"	25' 8"	22' 0"
7.2	65' 0"	25' 0"	22' 0"
14.0	33' 4"	12' 10"	11' 0"
14.2	32' 6"	12' 9"	11' 0"
21.0	22' 3"	8' 6"	8' 3"
21.3	21' 11"	8' 5"	8' 3"
28.5	16' 5"	6' 4"	5' 6"
29.0	16' 0"	6' 3"	5' 6"
50.0	9' 4"	3' 7"	3' 0"
52.0	9' 0"	3' 6"	3' 0"

Rotable Array

The rotable 8JK is constructed exactly the same as the fixed version, except no spreader arms are employed. Instead, 4 bamboo poles, 12 feet in length are used to support the ends of the antenna. A simple center construction is shown in Fig. 2. If trouble is experienced with "droop," the ends may be guyed to an extension of the mast, approximately 36 inches above the array.

Lead the phasing sections off to the mast and tape the coax, allowing enough slack for 180° rotation. No attempt will be made here to describe the various methods of rotation, as this will depend upon the individual installation. However, even the lightest duty TV type rotators will prove sufficient for this type of array at 14 mc. In the past at W6WAW most beams of this type have been hand rotated due to close proximity of the beam mounting to a window by the operating desk.

. . . W6WAW

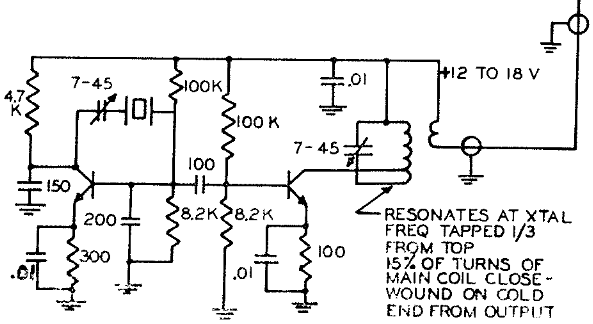


Ultra-Stable Xtal Oscillator

This unit is being used extensively for generation of stable frequencies for UHF. The osc. unit should be constructed on a small phenolic board and placed in a vacuum bottle, which may be buried in the ground. The plus 12 to 18 volts is carried on the center conductor of the co-ax so only one cable goes to the osc. Any good NPN rf transistors suitable for the xtal frequency used will give excellent results. This osc. will permit multiplication of a 7.814mc xtal times 162 up to 1266 mcs by means of a tube multiplier string and the results will be stable within cycles and give pure dc beat notes.

The 6AK5 buffer stage raises the 3 to 5 volts of rf at 51 ohms up to 50 to 60 volts at the Xtal frequency suitable for driving a string of tube multipliers. The Zener diode is a handy way to get regulated low dc for the oscillator from available B plus.

. . . K2TKN



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Double Sideband

FOR MANY YEARS there have appeared articles in amateur radio magazines which have compared two modes of radio telephony, namely amplitude modulation and single sideband. Most of these comparisons have been on the "equal" basis of the most simple and straightforward operation of each mode. Almost without exception, these articles treated each system with the same conditions, but neglected to say that when this is done, AM could be at its minimum effectiveness whereas SSB could be at its maximum effectivness. A common approach, has been to examine the ability of a given final rf amplifier stage by first assuming maximum operation of that stage in the AM mode and then using the same stage for SSB. Another approach has been to assume equal power *outputs* when the powers were considered to be the unmodulated AM carrier and the SSB output with tone input. In almost all such comparisons the voice modulating signal has been assumed to be identical for both modes ignoring the fact that certain types of voice processing are advantageous with one mode but not with the other. If two modes of voice transmission are to be compared, each mode should be treated wholly to itself, and not be limited by restrictions inherent in the other.

There are many amateurs who feel that the operation of the most effective mode is paramount and that the so-called savings such as total power consumed from the power line, overall size of equipment, possible higher packing density on the bands, high trade-in value when selling out, etc., are insignificant to them when compared to this goal. Therefore, the comparisons, which follow will consider three three modes of radio telephony from *only one view*. They will be compared only on the basis of the maximum effectiveness possible within the limitations of the amateur regulations, with optimum conditions available at both transmitter and the receiver. One of these limitations concerns the power that may be used by the amateur. This discussion will consider a maximum power station and the utilization of that power in the most effective manner. What then, is the maximum power that may be used? The definition of the maximum power limitation varies according to the mode of operation being considered. Since all three systems involve the use of audio signals, sine wave tone signals will be assumed unless otherwise noted. It will also be assumed that only the final rf stage supplies power to the antenna.

Power

AM

Conventional AM, double sideband with carrier is limited to 1000 watts dc input (the carrier) plus the power needed for 100% modulation. The *total* power input to a 1 kw AM station is therefore somewhat vague because the average amount of power needed for 100% modulation varies over a wide range. Because of differing voice characteristics, use of clipping or compression, etc., the average audio power might vary from 200 watts to well over 500 watts. Clipping has been used extensively in radio communications systems because clippers reduce and regulate the peak value of an audio wave. Therefore, clipping allows the use of higher depths of modulation and provides a safeguard against overmodulation. Voice of America engineers, after conducting detailed studies of means of combating jamming, reported that clippers provide signal-to-noise and interference improvements of approximately 9 db. These engineers further point out that clippers offer a basic advantage over compressors or limiters in that clippers operate instantaneouslv. Studies of many speech patterns show

that high-frequency sounds, necessary for good intelligibility, normally occur immediately after low-frequency, high amplitude sounds. Compressors, which are quick to reduce gain and slow to restore gain, effectively reduce the amplitude of these high intelligibility, high-frequency sounds. Clippers, being instantaneous in operation, do not suffer from this limitation.

It is possible to find a reasonable maximum average audio power figure for 100% modulated AM by assuming tone moduation instead of voice. A pure sine wave modulating signal would require 500 watts average power output from the modulator going into the final. Clipping and filtering of this sine wave would change its shape and significantly increase the amount of average power needed for 100% modulation. It does not seem unreasonable that with clipping, the average audio power in this example could be increased from 500 watts up to 800 watts or more. Therefore, the legal total power input to the final rf stage of an AM transmitter might well be 1 kw of dc power (for the carrier) plus 800 watts of audio or a total of 1800 watts. The dc power input to the final stage of an AM transmitter is determined by metering the plate voltage and the plate current and by using Ohm's Law that P = E x I. An oscilloscope can provide a means to determine when the degree of 100% modulation occurs, but will not indicate the average power of the audio needed to attain this point. However an audio average power indicating device is not required. Thus, the only power determining devices needed to meet requirements are a dc plate meter and a dc ammeter. It should be noted that dc devices read average and that the average of an ac signal amplitude is zero, so that both instruments remain at the same reading with or without modulation. It should also be noted that the peak envelope power of a 1 kw AM transmitter modulated 100% is equal to 4 kw.

SSB

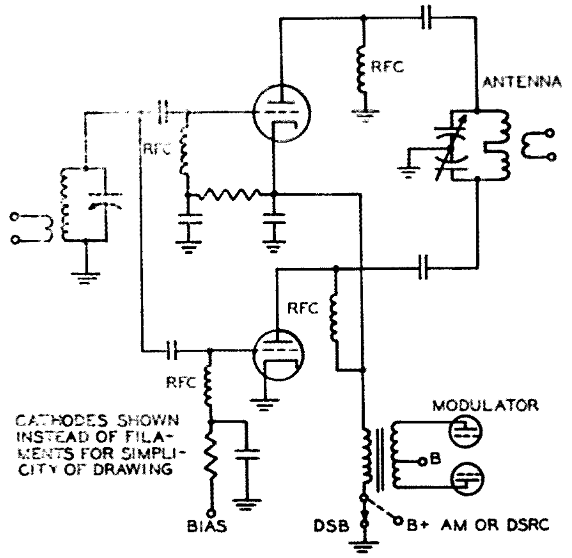
Single sideband suppressed carrier has a power limitation of 1 kw average dc input to the final rf amplifier stage. With an average voice as the program source and proper metering, this results in an actual peak envelope input of 2 kilowatts. Speech has occasional high power low-frequency (say 200 cycle) components which if clipped become nearly square waves. When a square wave is sent through a typical low-pass filter which may pass up to the 11th harmonic, and then used to modulate an SSB transmitter, the peak rf power is increased three times over what it would be in AM modulation. To avoid exceeding the peak power limitation of the law (or of the tubes being used) the average signal level must be reduced to one-third. Heavy clipping is not effective for SSB as distortion results due to the inability of a linear response to the waveform and there is a further loss of readability in the presence of noise.

Since a dc power supply is the only source of plate input power, only the means of determining this power need be considered. As in conventional AM, a dc voltmeter and dc ammeter are used at the plate of the final rf stage. The dc voltage remains constant while the ammeter varies in accordance with the amplitude and shape of the low level input signal to the final linear amplifier. Here, as in AM, the average of the peaks of the modulating signal controls the average power as much as does the amplitude, and the dc ammeter will respond to changes in either. This means, that with a fixed maximum reading on a dc ammeter as a guide, that audio with occasional high peaks and a low average will achieve a high peak input power on those peaks. Audio having little difference between occasional peaks and the average will have a lower peak input power on those peaks, but have a higher average peak input. The average input power is the same in both of these cases, for the dc ammeter was used to equate the powers and it is an average reading device when in the presence of a varying signal. Because of the character of the current flowing in the plate circuit, a specific degree of damping of the meter movement is required. This is reasonable because it can be seen that a meter having a very high degree of damping would result in a much higher input power for a given meter reading than a meter having a low damping figure. The meter used by amateurs transmitting SSB is required to be quarter second damped. Using Ohm's law, that P = E × I, the reading on such a meter while the operator is talking is used with the known dc voltage to determine the power input, the maximum being 1 kw.

DSB

Double sideband with no carrier is usually thought of as being similar to SSB in a general sense, both systems being low level modulation systems having the ability to cancel out the carrier. However, the double sideband system described in this article is a high level modulation system which also has the facility of reducing or even eliminating the carrier.[1] The important difference, as far as power is concerned, is that the former requires a final amplifier of relatively low efficiency whereas the latter uses a high efficiency amplifier. As shown

FIG. 1



in Fig. 1, a pair of tubes are used in an rf amplifier in such as fashion that they are connected back-to-back as far as the plate power source is concerned. Such a device properly operated will pass electron current in either direction equally well. Properly connecting grid and plate rf circuits and applying an ac voltage of audio frequencies to the plate input results in a double sideband, no carrier, output signal. Since modulation takes place in the plate-cathode circuit of both tubes, both tubes may be operated at Class C efficiency. It can be seen that since there is no dc voltage involved, that a dc ammeter placed in the transformer secondary circuit would read zero. The average of an ac voltage is zero, and in varying about ground the average voltage on the final is zero. Thus, dc instruments for voltage and current would result in apparently zero power regardless of the amount of ac or audio power used. It seems reasonable that ac rms meters may be used to measure the power input in this circuit. Since both plate voltage and plate current vary with the speech, then *both* meters would be quarter-second damped. It should be pointed out that an rms reading meter reads .707 of the actual peak value of voltage or current. The voice controlled metering is utilized for both current and voltage and at the same time, the values read rms. In SSB operation, using a fixed dc voltage, the peak envelope power is twice the metered average power, that is, 2 kw PEP for 1 kw average input. The quarter second damped meter affords this advantage. In this DSB transmitter, *if* the two quarter second damped meters were *peak* reading, then a 1 kw average input would result in 4 kw peak envelope power, the same as the AM transmitter. However, to measure average power, rms reading meters are used. Thus when 1 kw average power would be indicated by the two rms reading meters during speech, each reading would be multiplied by $\sqrt{2}$ to calculate peak values.

$\sqrt{2} \times E \times \sqrt{2} \times I = 2 \times P$. The peak envelope power would then approach 8 kw. It should be noted that the circuit shown in Fig. 1 can be used as a straight AM transmitter simply by returning the modulation transformer to a power supply instead of ground. Suppose then that a dc power supply is connected to the modulation transformer of sufficient voltage such that the final amplifier may be loaded to 1 kw of dc power and afford a match to the modulation transformer. Assume that the transmitter is modulated 100% with a clipped and filtered sine wave tone causing a total average input power of 1800 watts. If the voltage from the power supply were gradually reduced and the audio power gradually increased until the dc input was 900 watts and the audio power 900 watts, the total average power would still be 1800 watts. At this point the carrier would be modulated in excess of 100%. The waveform of the rf envelope would not however contain any distortion because the DSB circuit provides a continuous response of the proper rf phase to the entire applied audio signal regardless of the polarity. Thus although the applied dc voltage was over-modulated there are no spurious sidebands created. The 900 watt carrier and 900 watts of audio add up to the same 1800 watts as our sample optimized AM case. Suppose now that the carrier is further reduced by lowering the dc voltage and the audio power increased. At almost zero dc voltage the carrier could be reduced to 1 watt and the average audio power could be increased to 1799 watts, still the same total average input power as the optimized AM station. Of course this 1800 watts average input power would be, for practical purposes, all in sideband power.

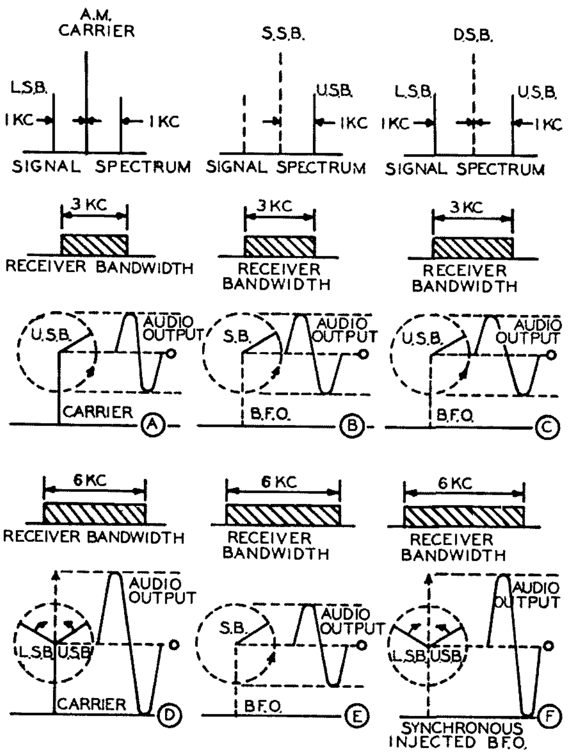
Efficiency of the Final Stage

It should be noted that the selection of certain voltage to current ratios can improve the efficiency of either a linear amplifier or Class C amplifier. It will be assumed that any comparison of efficiency between the two has been equalized by treating each under the same conditions.

AM

Conventional high level modulated AM can be operated at the efficiency afforded by Class C operation. This will be considered here as

FIG. 2



75%. At this efficiency, out of the total of 1800 watts average input power in the optimized AM case, the total average power output will be 1350 watts. Of this, 750 watts will be in the carrier. The average sideband power output will be 600 watts split into two sidebands of 300 watts each.

SSB

The efficiency of a single sideband suppressed carrier linear amplifier will be considered here as 60%. At this efficiency, out of the total of 1000 watts average input, the average sideband power output will be 600 watts in one sideband.

DSB

The double sideband amplifier herein described can be operated at the same efficiency as the AM station. With the same total average input power as the AM station the average power output will be 1350 watts. This is the same as the output power of the AM transmitter except that all the power is in the sidebands, each sideband containing 675 watts.

Reception Capabilities

For the purpose of this discussion, it will be assumed that the signal to be received contains information up to 3 kc.

AM

The most common method of detection of conventional AM is through the use of a linear detector. Assuming the bandwidth of a receiver accepts both sidebands and the carrier, the detector uses the carrier to demodulate the sidebands. The carrier, being of proper phase, the two sidebands add together to form the audio output from the detector. By having such a receiving bandwidth, in this case 6 kc, the AM signal is more susceptible to interference than a mode of reception which is more narrow. AM can be detected by the single sideband method. However, in this case fully half of the sideband power is discarded. Although only half the sideband power is used, it is very important to remember that the other sideband is immediately available. Thus, the sideband experiencing the least interference can be continually selected under varying conditions of interference.

A third method of reception would be the use of a synchronous detector as proposed by W2CRR.[2] This method ignores the presence of the carrier and uses the synchronous information appearing in the two sidebands to control a product detector. The system adds the two sidebands of a double sideband signal and allows the operator to select the interference to be rejected, which might be present in one of either of the two sidebands. It accepts the desired signal appearing in 6 kc of the spectrum, yet affords an effective 3 kc bandwidth in regard to interference and noise.

SSB

Normal single sideband reception can be accomplished by carrier insertion using a 6 kc or a 3kc bandwidth. Naturally, since all the transmitted signal is in one sideband the 6 kc system does not warrant attention. In the 3 kc bandwidth position all of the transmitted signal is received as in contrast to single sideband receiving AM. The facility of changing sidebands is of course available, but the need to change sidebands is not immediately apparent to the transmitting operator.

DSB

In double sideband no carrier reception, we take advantage of having all the transmitted power in the sidebands as in SSB and by using the system of synchronous reception also take advantage of the effective 3 kc bandwidth. In addition, we can immediately select either one of two adjacent 3 kc portions of the spectrum at the discretion of the receiving operator.

System Performance

AM, SSB and DSB will be compared under

a condition where sine wave tone modulation is used and the 9 db reception improvement possible with clipping for AM and DSB transmission is ignored.

Assume that reception with 3 kc bandwidth for AM, SSB and DSB is to be considered. The left-hand group of drawings in Fig. 2 shows what takes place in receiving the AM signal. The spectrum of the signal consists of the carrier and upper and lower sidebands, spaced 1 kc either side of the carrier. Since 100 per cent modulation is assumed, each sideband has exactly one-half the carrier amplitude. The signal is tuned in so that the carrier is placed at the low frequency edge of the 3 kc bandwidth for reception of the upper sideband only. The signal arriving at the second detector consists of the carrier and the upper sideband. The resultant audio signal in this case is the beat between the two, and it is generated in the second detector by the vector process shown at (A). The instantaneous amplitude is equal to the vector sum of the carrier and the sideband, but since the two are on different frequencies this sum varies at a rate equal to their difference. This is represented by the circular path followed by the extreme end of the sideband vector, and in this example the sideband vector would rotate 1000 times a second with respect to the carrier vector. As the total amplitude varies from the carrier level to maximum and to minimum and back, it generates the audio signal.

In the single sideband case, shown at center, only the upper sideband is transmitted. The upper sideband is inside the 3 kc bandwidth of the receiver, and at the second detector the BFO is used to supply the missing carrier. At (B), the BFO amplitude is shown the same as that of the carrier in the AM case. The sideband is shown with the same amplitude as in the AM case; the process of generating the audio output is the same, so the audio signal at the second detector is exactly the same as in the AM case.

The double sideband case is shown at the right. It can be seen that only one of the two sidebands will be accepted by the 3 kc bandwidth; that the BFO injection will be necessary for detection, and that with an upper sideband amplitude equal to the AM and SSB cases the output audio signal (C) will be equal in amplitude.

Assume that the upper sideband power *output* in each case is 100 watts. An AM transmitter running 533 watts carrier input at 75% efficiency with 1 kc tone modulation at 100% would have 100 watts output in the upper sideband. A SSB transmitter running 166 watts input at 60% efficiency with 1 kc tone modulation would have 100 watts output in the upper sideband. A DSB transmitter running 266 watts input at 75% efficiency with 1 kc tone modulation would have 100 watts output in the upper sideband. Using a 3 kc bandwidth for receiving, and assuming tone modulation with no audio processing, it can be seen that an SSB signal having an input equal to the carrier of an AM signal would have a detected output 3.2 times (5 db) the output of the detected AM signal (assuming 533 watts input at 60% eff. = 320 W). Likewise, an SSB of 266 watts input would have a detected output 1.6 times (2 db) the detected output of the DSB signal.

The comparison just conducted was favorable to the SSB signal because of the bandwidth of the receiver. Consider the use of synchronous detection for receiving signals having double sidebands. In the lower section of Fig. 2 the AM carrier and its sidebands are drawn to the same scale as above for easy comparison. However, the receiver bandwidth for the AM signal is now 6 kc and both sidebands contribute to the audio output. While each sideband traces a circle, in the vector diagram, they rotate in opposite directions and at the same rate, so that the vector sum is not traced by the circle but moves up and down along the

same line on which the carrier lies. When both sideband vectors are along the same line as the carrier and are pointing upward, their sum is equal to the carrier amplitude and the total amplitude, carrier plus sidebands, is equal to twice the carrier amplitude. When both lie on the carrier line pointing downward, their sum is again equal to the carrier amplitude but the direction is opposite, so the total amplitude is zero. Thus, the instantaneous amplitude varies between zero and twice the carrier amplitude and the audio output (D) is equal to these variations.

In the center, for SSB, the same sideband amplitude has been retained; that is, the amplitude is the same as that of one sideband of the AM signal. In fact, everything at (E) is identical with (B). The audio output has exactly half the amplitude of the output from the AM signal and so has only one-fourth the power of the detected AM signal. On the right side at (F), for DSB, the same amplitude sidebands appear as at (C), and here, with synchronous detection, the audio output amplitude is equal to the vector sum of both sidebands. This is possible because synchronous detection provides an automatic system which controls the frequency *and* the *phase* of the BFO and exactly replaces the missing carrier which is needed.

Assume 100 watts *output* for the upper sideband, and the same efficiencies and modulation as before. It will still require an AM transmitter of 533 watts input, an SSB transmitter of 166 watts input, and a DSB transmitter of 266 watts input. The audio output amplitude for both the AM case and the DSB is twice that of the SSB and thusly is four times the power. Equating the output of the detected audio amplitudes by adjusting the power inputs at the transmitters, the AM and DSB inputs must be divided by four. The power inputs for equal detected audio outputs are 133 watts input on AM, 166 watts on SSB, and 67 watts on DSB.

As a function of the method of reception, DSB has gone from second place to first place in the power input comparison. As before, if equal power inputs are assumed, 166 watts input on DSB would have a detected audio output 2.5 times (4 db) that of the detected output of a SSB signal having an input of 166 watts. An input of 133 watts on DSB would afford a gain of 2 times (3 db) over AM. An input of 166 watts on AM would afford a gain of 1.25 times (1 db) over SSB. It should be remembered that synchronous detection permits the ability to receive the 6 kc of the DSB signal and at the same time offers an effective 3 kc bandwidth as regards interference and

noise. It should also be noted that the power comparisons were for steady *tone* modulation. The Voice of America engineers found that 9 db gain in signal to noise ratio can be obtained by proper voice processing and if a change from *tone* modulation to voice is made, the advantages of DSB are great indeed. Assume that the three systems are to be compared on a voice basis, that *optimum* conditions exist for each mode at both the receiver and the transmitter cases (B), (D) and (F), and that the instantaneous peak envelope input power for each mode does not exceed that of the previous comparison using tone modulation. It is possible for DSB using voice processing, under these conditions, to afford a gain of 10 db over SSB.

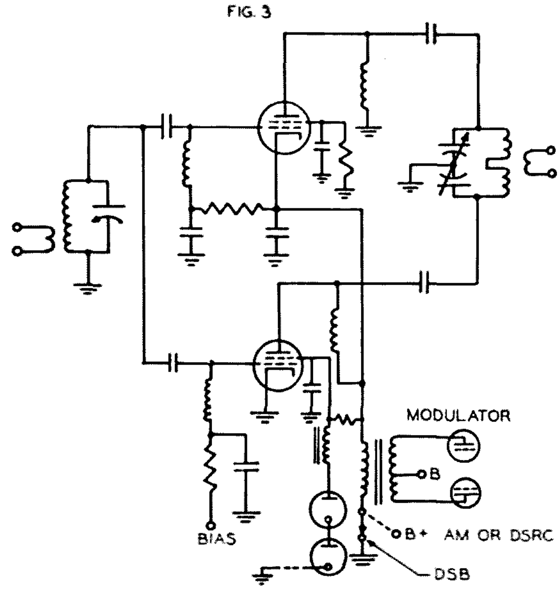
Now, setting aside the comparisons based on output power or peak power and assuming each transmitter to be operated at the amateur legal limit of average input power as measured according to the methods previously discussed, DSB gains an additional advantage over SSB. The total average output power in the sidebands of the AM signal was 600 watts; in the sidebands of the DSB was 1350 watts; and in the sideband of the SSB was 600 watts. Assume the use of synchronous detection for the AM and DSB signals and normal BFO injection for SSB. It can readily be seen that DSB enjoys an advantage of 4½ times the detected audio output power of the SSB signal; 2.25 times the detected audio output power of the AM signal.

A Further Description of the DSB Circuit

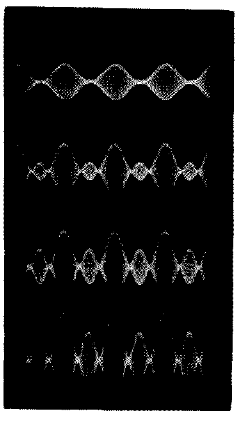
A plate modulated AM transmitter can be converted to DSB with little effort or additional expense. All existing stages of rf and af except the rf final can be used. A rig already having two tubes in parallel or push pull easily lends itself to the conversion. It should be noted that PI network output is possible by using shunt fed push-pull grids and shunt-fed parallel plates. A neutralized rf final already using two tubes merely needs the addition of a filament transformer, a grid resistor and the shunt chokes and capacitors.

The circuit shown in Fig. 1 is not confined to the use of triodes. Tetrodes, which require much less drive, can be used. No additional supply is needed. Each screen should have the proper screen resistor returned to the same source as its respective plate. This is shown in Fig. 3. When using either circuit, initial tune-up must be done in the AM position, that is, by applying a known dc voltage to the modulation transformer. Application of rf drive will

FIG. 3



cause the carrier tube to respond in a normal manner and the grid current should be maximized and the plate current dipped to resonance. If tetrodes are used, the plate and screen current will indicated on a common meter and this total current should be used when determining the match to the modulation transformer. The fixed bias supply is used so as to protect the rf final in the event of failure of the drive. The series grid resistor provides any bias above the minimum fixed voltage needed. It is necessary that the total bias on both tubes be equal and that the value is sufficient to ensure Class C operation over the entire range of voltage which may appear on the plates. The audio choke and VR tubes at the screen of the carrier tube ensure that any dc shift in screen voltage, which could result from a failure of drive, is restricted to a small value. Without this circuit, under a no drive condition the screen voltage would rise to the plate voltage, and the fixed bias would no longer be at cutoff. If it can be determined that the grid drive and grid bias (and for tetrodes —the screen resistor) are the same for both tubes and that both tubes are treated identically, in an rf sense, then there is good assurance that the two tubes will respond equally. Of course, an oscilloscope can be used to ensure this. Application of a tone input while in the DSB position will provide the classic DSB envelope pattern. If there is a difference in adjacent peaks of the DSB envelope pattern, the series grid resistors can be changed, one at a time, until a classic pattern is obtained. Since the rf circuit is a balanced modulator, there should be *no* need for neutralization. With no modulation, any rf appearing in the plate circuit while the modulation transformer is returned to ground, will probably be due to poor engineering layout and should be corrected by changing the layout.



A—100% Modulation

B—200% Modulation

C—300% Modulation

D—400% Modulation

Conclusion

The circuit of Fig. 1 has been in use by the author for two years and has proved to be very effective. The transmitter is operated as a double sideband reduced carrier rig, running 600 watts dc input and 1200 watts peak audio input (See Fig. 4B). The carrier (600 W) permits detection of the signal with an AM receiver with some accompanying distortion. Although very few synchronous receivers are in use today, the DSB signal does well with ordinary SSB receiving techniques. The synchronous detector was built as an adapter to an existing receiver, being connected to the output of the last if amplifier. It seems that when double sideband is transmitted and received in an efficient manner it has a considerable advantage over the other modes. The simplicity of the circuit and the possible conversion of an existing rig should appeal to the home brew addict. The use of an SSB receiver to receive DSB, selecting the sideband most clear of QRM, should prove an intermediate step to synchronous detection.

In conclusion, it is intuitive that the concentration of all the sideband power in one sideband results in an advantage, however, it is equally intuitive that the more narrow a signal becomes the more susceptible to interference it becomes, or, the more difficult it is to tune out interference. Of course, only the receiving operator is able to choose which sideband about a given frequency is most clear of interference at any given instant and this choice is continuously available with double sideband.

. . . W3PHL

[1] **Over Modulation Without Splatter,** O. G. Villard, June 1947, QST; Jan. 1947, ELECTRONICS.
[2] **Synchronous Communications,** *(Costas, p. 1713, Dec. 1956, IRE)*

Some Double Sideband Reference Material

1. **Synchronous Detection of AM Signals**
   Proc. NEC pp 121-129, Oct. 1951

2. **Synchronous Communications**
   Proc. IRE, Dec. 1956
   "If equal average powers are assumed for SSB and synchronous AM it can easily be shown that identical S/N ratios will result at the receiver. The additional noise involved from the reception of two sidebands is exactly compensated for by the coherent addition of these sidebands. The 9 db advantage often quoted for SSB is based on a full AM carrier and a peak power comparison. If intelligent jamming rather than noise is considered there exists a clear advantage of two-to-one in average power in favor of synchronous AM."

3. **DSB vs. SSB Systems**
   Proc. IRE, April 1957, pp 534-538
   ". . . AM, if brought up to date by giving it the same advantages (carrier suppression, improved frequency stability, and improved receiving techniques) proposed for SSB, would be by far the more desirable system." "For a good many years now various groups have been attempting to convert the radio amateur to SSB and to date these groups have enjoyed some measure of success.. Recently a small number of amateurs have been told about DSB and have been using the modulation method. Some of these people have employed clipping and filtering in their equipment and their experiences to date seem to bear out the claim that there is a sizable power gain over SSB to be had. Thus, we may be facing an actual battle between DSB and SSB for survival under conditions that in many respects are not unlike the conditions to be found in a military combat area. Although any amateur operating experience must be interpreted very carefully when applied to areas outside this field, the results of the DSB-SSB battle on the amateur bands bears some watching. This situation will be altered, of course, by any amateur regulations which discriminate against DSB either on an input power basis or by giving SSB exclusive use of certain frequency assignments."

4. **The Use of Speech Clipping in SSB Communications Systems**
   Proc. IRE, Aug. 1957, p. 1148
   ". . . It would appear that the important advantages obtainable by the use of simple clipping systems may not be fully enjoyed by conventional reduced or suppressed carrier SSB systems."

5. **Selection of Modulation for Speech Communication**
   ELECTRONICS°, March 1958, p. 56
   An analysis of AM, DSB, SSB, and FM, showing DSB to be the best overall system of communication.

6. **AM Transmitters as SSB Jammers**
   Proc. IRE, Dec. 1958, p. 1960
   A properly placed 125 watt output AM signal with speech clipping effecively jams a 1 kw output SSB.

7. **Poisson, Shannon and the Radio Amateur**
   Proc. IRE, Dec. 1959, p. 2058
   "Congested band operation as found in the amateur service presents an interesting problem in analysis which can only be solved by statistical methods. Consideration is given to the relative merits of two currently popular modulation techniques, SSB and DSB. It is found that in spite of the bandwidth economy of SSB this system can claim no overall advantage with respect to DSB for this service. It is further shown that there are definite advantages to the use of very broadband techniques in the amateur service."

8. **Poisson, Shannon and the Radio Amateur**
   Proc. IRE, Aug. 1960, p. 1495
   DSB vs. SSB in the presence of jamming.

9. **Traffic Efficiencies in Congested Band Radio Systems**
   Proc. IRE, Nov. 1960, p. 1910
   DSB vs. SSB

10. **Suppressed-Carrier AM**
    QST, March 1957, p. 19

11. **The AM Equivalent of SSB**
    QST, Jan. 1954, p. 19

12. **DSB vs. SSB**
    QST, May 1957, p. 42

13. **High-Level Balanced Modulator for DSB**
    QST, April 1960, p. 22

14. **Single Sideband Communication**
    Proc. IRE, March 1961, p. 632
    "SSB's principle "advantage" is its spectrum conservation . . . examining Shannon's equation for channel capacity
    $c \quad w \log_2 ((11 + P/N)$ .....
    it can be readily seen that the required receiver signal-to-noise ratio goes up exponentially as the channel bandwidth is reduced."

15. **Double Sideband**
    CQ, Jan. 1957, p. 26

Stutterless Vox

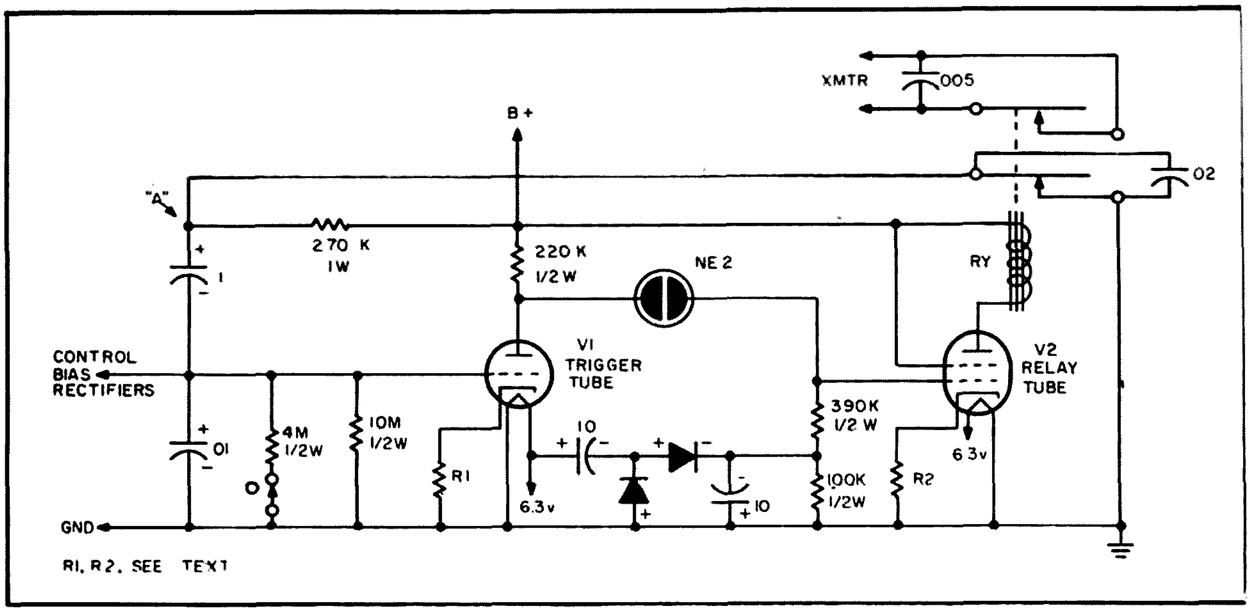
Harvey Pierce WØOPA

IN an ordinary VOX circuit, there is sometimes the problem of relay stutter at marginal levels of voice input. There is also the problem of quick pull-in and proper delay. If the bias rectifier capacity is small enough to charge fast, it is too small to give adequate delay.

In the circuit shown VI is the trigger tube (almost any triode will do) with its cathode resistor R1 adjusted so it draws enough current to keep the NE2 bulb from firing. As soon as some negative voltage from the control rectifiers appears on its grid, the NE2 fires, applying a positive voltage on the grid of the relay tube, cancelling its cutoff bias from the bias supply (a voltage doubler from the heater circuit).

As V2 conducts, the relay closes, with one set of contacts turning on the transmitter, while the other set grounds point "A." This puts the .1 mfd capacitor in parallel with the .01 capacitor in the grid circuit of the trigger tube. And, as the .1 capacitor has been charged from the plate supply in the polarity shown, the trigger tube acquires a substantial charge that keeps the transmitter from immediately going off the air or chattering, and the added capacity increases the delay time for talking.

As the operator stops talking, and the NE2 goes out, bias is restored to V2. The relay opens, and the .1 capacitor charges. During this charge time the trigger tube grid is held positive, holding the transmitter off the air for



a short time, again preventing stutter.

The cathode resistor of V2, R2, is selected to limit the current thru the tube to that recommended for the relay. V2 is shown as a beam tetrode, but a pentode or triode can be used instead, depending on the current required for the relay used. Other resistors are of typical values. Switching in a 4 meg resistor in parallel with the 10 meg gives a choice of long or short delay, but a 10-meg variable resistance could be used instead. Plate supply voltage should be over 150 volts.

The .1 mfd capacitor must be of high quality, with over 1,000 megohms leakage resistance. The capacity may be increased or decreased, if desired, to increase or decrease the hold time.

For those who have been bothered in the past by having their home-made VOX re-cycle or motorboat, this is a cure. The real cause is switching transients, however, and a cure can be had without building this circuit by carefully "de-sparking" each and every contact in the transmitter-receiver control circuits. Personally, I prefer this circuit. . . . WØOPA

Ballast Replacement for the NC-300

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SHORTLY after purchasing my National NC-300 receiver, the 4H4C ballast burned out. At that time I ordered a replacement and a spare. Since then, the spare has been used and replaced. The receiver has been very satisfactory except for these frequent ballast replacements.

Other NC-300 owners have voiced the same complaint, so it seemed logical to look for a solution. One ham replaced the ballast with a 6V6-GT. He sacrificed stability for reliability, as this ballast is used to stabilize the first oscillator heater current.

The following solution should be quite reliable and offers improved heater voltage regulation. A transistorized voltage regulator was built which plugs into the 4H4C socket. The only modification to the receiver consists of soldering ground leads to pins 1 and 8 of the 4H4C socket.

The first oscillator heater circuit is shown in Fig. 1.

The circuit in Fig. 2, replaces the 4H4C ballast.

This regulator-rectifier supplies 6.2 VDC with less than $\mp$.1 volt variation over an AC input range of 105 to 130 volts. Resistor R_3 is necessary if the output voltage is high. In my case, the output was 6.4 volts. A .47 ohm resistor was added to bring the output down to 6.2 volts. The value of this resistor is determined by Ohm's Law. (6.4-6.2) divided by .45 (heater current) equals .44 ohms. I used the nearest available value.

My unit was built on a 2¼" x 4⅜" aluminum plate. This plate was soldered to the metal base of a discarded 2E26 tube. The aluminum to brass soldering job is easy if SAL-MET flux is available. If not, the plate can be bolted to the socket. The plate should

be oriented as shown in the drawings (Fig. 3). The 2N257 transistor was mounted in a Motorola MK-15 mica insulated socket. The 2N270 was mounted by its leads. None of the wiring is critical and the transistor types were chosen because they were available. Almost any diamond shaped power transistor will replace the 2N257. The 2N270 can be replaced by a PNP, audio type, transistor having a collector dissipation of 150 mw or better.

. . . K6GVB

—Parts List—

Q1 Sylvania 2N270 transistor, or equiv.
Q2 Sylvania 2N257 transistor, or equiv.
CR1 Motorola ¼M6.8Z10 zener diode, or equiv.
CR2 Diodes Inc. DI-56 silicon rectifier, or any .75 amp, 50 piv Diode.
C1 Sprague TVA-1162, 500 mfd. @ 15 v.
TRANSISTOR SOCKET Motorola MK-15.

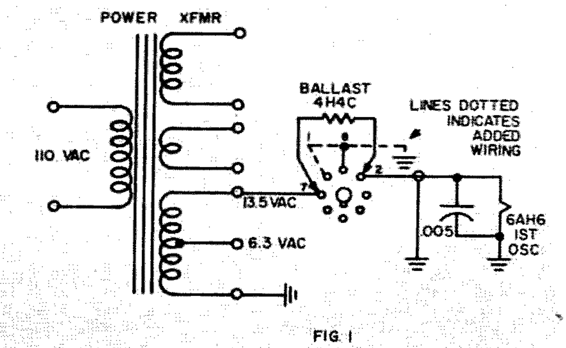


FIG. 1

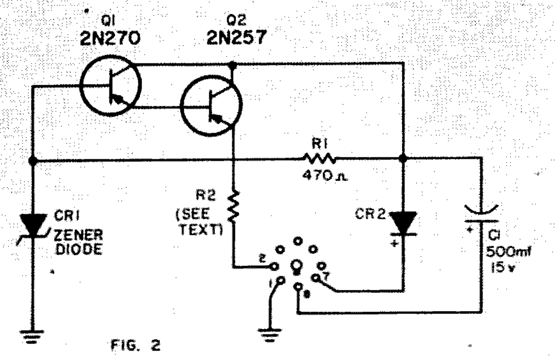


FIG. 2

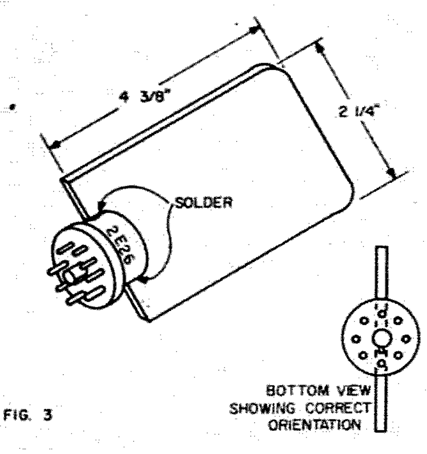
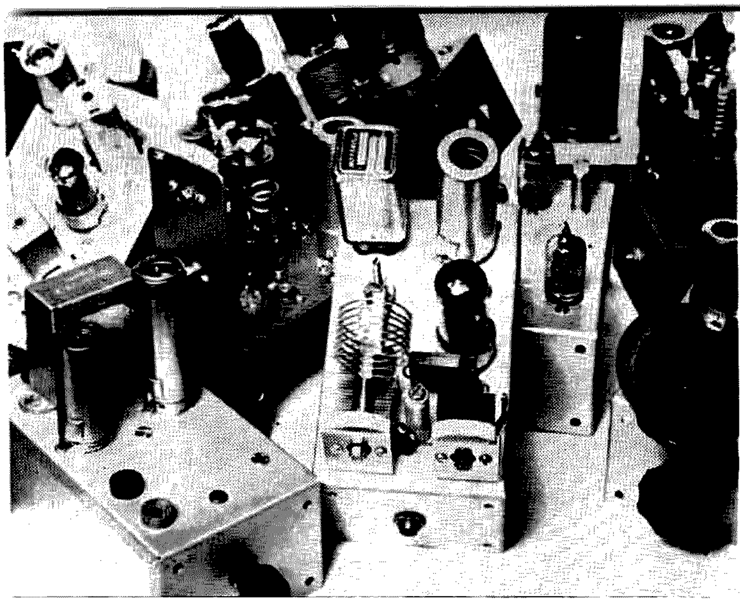


FIG. 3



Modules

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THE OLD SAYING "If it works it is obsolete" pretty well sums up why hams who like to try new circuits and build new gear just keep right on trying and building. This sort of philosophy is good for the progress of the art, but it usually results in a chassis that looks as though it had taken a charge of buckshot at twenty paces.

After several modifications to modifications, what started as a super het may end up as a transmitter. Or, it may never end up. Not only is the chassis lost but most important is the time lost in duplication between projects.

There may be several answers to the problem but one is as simple as a set of A B C building blocks. It is the use of modules. Perhaps the first attempt at a module system *was* a set of A B C blocks. In the A B C system the same units can be used over and over again to build many words. A similar system used for communications and electronics circuits can work equally well to build many combinations.

Nearly all circuits break down into natural blocks. We all use the block diagram every day. If each of the individual blocks is constructed as a separate physical unit, its use is multiplied many times. Nearly all of the blocks can be used over and over again in many circuits. Commercial builders are using the system to save time and money; amateurs can do the same. In addition the ham builder will get more enjoyment from the hobby.

If an item such as a receiver is constructed in modules, each block of the diagram can be completed one at a time. Each can be tested and made operational before proceeding to the next. It is not necessary to wire completely a large chassis before any circuit can be tested. The same applies to transmitters. If somewhere along the line a buffer turned out to be a duffer, just pull out that section and try again.

In ham fashion, each builder may want to develop his own system, but in any case several basic rules should be followed. To be successful, all units should be the same general size and shape. They should require as little sheet metal work as possible. The basic chassis that is chosen should be inexpensive and one that is available at almost any parts house. After many false starts, the 2¼ x 3 x 5¼ inch aluminum box was found to be a good answer. Almost any basic circuit can be put on one of these when used as a chassis, and this chassis also meets the other requirements.

As each new home project is tried, a new module (or modules) is assembled as needed. After the project has "cooled" down and it has served its purpose, the modules are added to the shelf collection for further use when needed. As the collection grows it becomes possible to assemble almost any circuit merely by pulling the desired building blocks from the shelf and inter-connecting them with a few pieces of wire.

In time the collection will grow and even the first module built will still be giving good service. A typical collection may include such items as these:

1. Audio amplifiers.
2. 455 kc *if* amplifiers
3. 10.7 mc *if* amplifiers
4. Tuneable front ends for VHF receivers
5. Tuneable front ends for HF receivers
6. Crystal controlled front ends
7. Transmitter exciters
8. Transmitter buffers and amplifiers
9. Transmitter finals up to over 100 watts
10. Regenerative second detectors
11. Superregenerative second detectors
12. Low power modulators

The list will also have items that are slanted toward the special interest fields of each builder.

For the ham who would like to try the system, several sample units are shown. The modules shown in Fig. 1 can be used to make a low power transmitter or exciter for either the 6 or 2 meter band. The center unit is a crystal oscillator and one stage of multiplication. The output is in the range from 28 to 54 megacycles. Almost any fundamental cut crystal above 6 megacycles can be used. This unit can be used to drive the module on the right which is a 2E26 amplifier with output on 6 meters. Or, for 2 meter operation the center module can be used to drive the unit on the

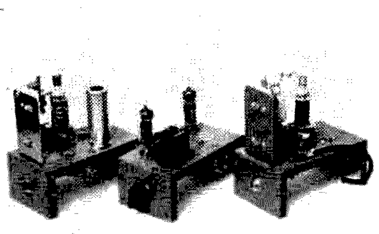
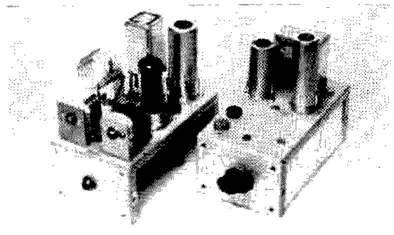
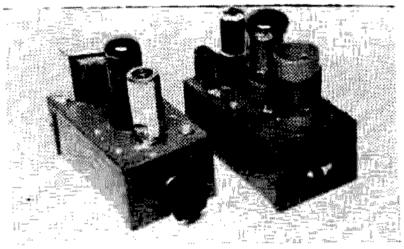




Fig. 1. Three modules can make either a 6 or 2 meter transmitter. The center chassis is an oscillator and multiplier. Two meter final is on the left and the six meter final on the right. Fig. 8 shows an underside view.

Fig. 2. A complete 10 meter phone transmitter, or a driver for a higher powered final.

Fig. 3. A low frequency phone or CW transmitter. A single channel transmitter that will handle up to about 30 watts on CW. It will also serve as the driver for a larger final.

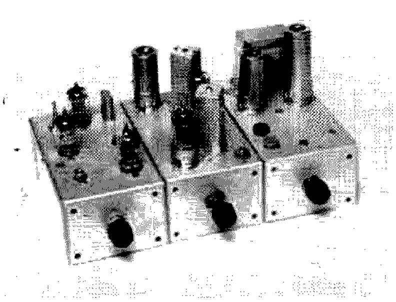
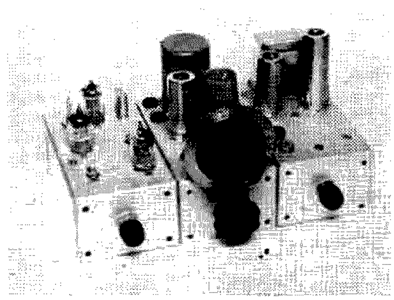
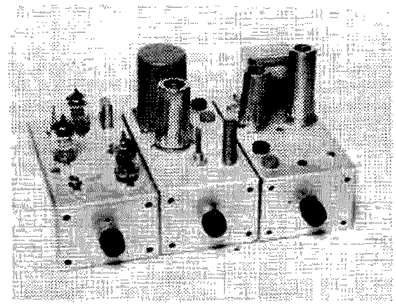




Fig. 4. Three modules will form a crystal controlled receiver. The audio module is the modulator used in the 10 meter rig shown in Fig. 2.

Fig. 5. A variation of the receiver of Fig. 4 using a tuneable regenerative *if* system.

Fig. 6. For those who like to try super-regen circuits, the same receiver now uses a super-regen *if* module.

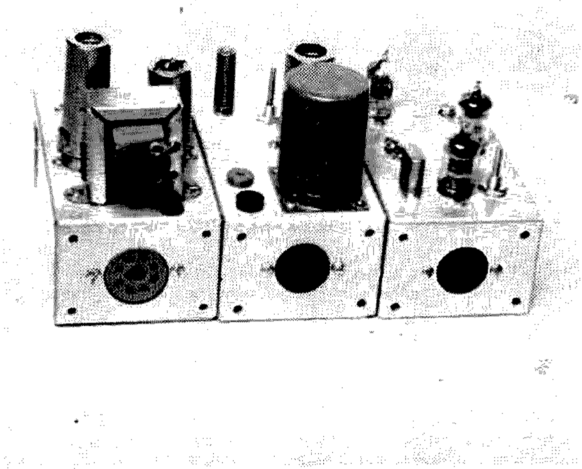
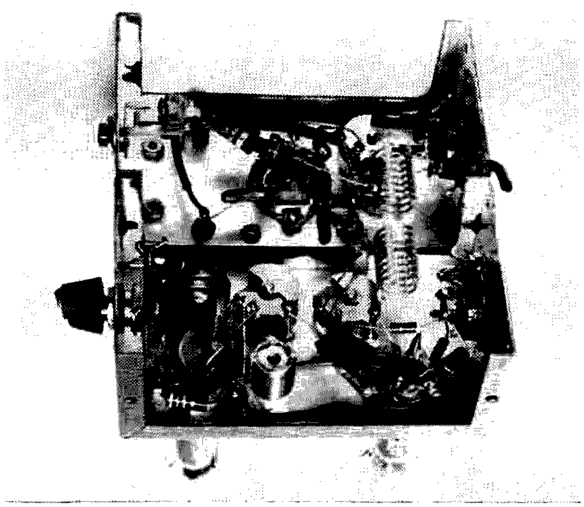



Fig. 7. In many of the modules the power is brought in at the rear of the chassis. An octal socket is used for power and interchassis connections.

Fig. 8. This view shows the underside of two modules. These are two of the units shown in Fig. 1. Inductive coupling between units eliminates the need for interconnecting rf links and the like.

left which is another stage of multiplication driving a 2E26 final amplifier on 2 meters.

The unit shown in Fig. 2 can be used as a low power transmitter on ten meters, or it can be used as a driver for a more powerful final amplifier. This model even has room for a temperature-controlled crystal oven. Shown with this module is a low power modulator. This audio module is wired to accept either microphone input or input from a receiver detector. In this way it can be plugged in as either a low power modulator or the audio section of a receiver.

The pieces shown in Fig. 3 make up a low frequency phone or CW transmitter. This one is suitable for the beginner or as a standby unit. It can also be used as the basis for a mobile installation.

Thus far we have shown only transmitter combinations. For those who build receivers

the system works even better. Fig. 4 illustrates how the modules fit in for this use. From left to right is a crystal controlled front end, next is the *if* system and to the right is the audio output. The audio unit is the same one used as a modulator in Fig. 3.

In the combination shown in Fig. 5, the fixed tuned *if* system has been replaced with a tuneable, regenerative *if* unit. The advantages of a superregenerative *if* system can be investigated with the combination shown in Fig. 6, or a VHF front end is fed into a 10.7 mc *if* amplifier.

A few details on the mechanics of the system may be of help. The illustrations all show four holes in each end of each chassis (near the corners). These holes are used to mount the units to a rack panel if one is used or to a small panel if the units are kept single or in twos or threes. They also help to make the units interchangeable. If one "beneath the chassis" control is to be used it is placed in the center front of the modules. If two controls are needed they are spaced evenly in the front. To assure that all chassis are drilled symmetrically, a template was made from a piece of sheet metal. The pattern of holes is drilled in both ends before any layout work is done. The hole in the center of the rear of the chassis can be used for power or signal connections as desired. Of course for some units additional holes will be required for connectors in the rear.

In addition to panel mounting, the small chassis can be bolted together through the small flange along the sides to form a larger chassis base. This method of attaching the units together forms a very rigid type of construction.

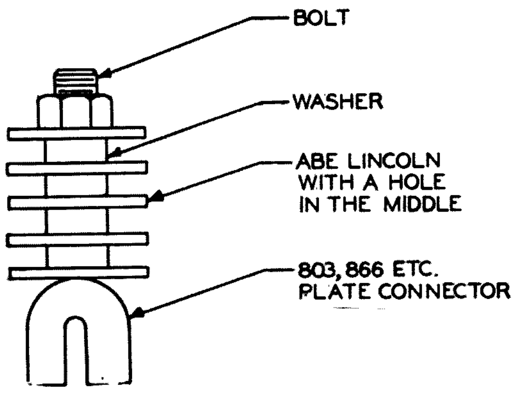
In circuits where it is likely that the units may be changed quite often, the power connections are brought out to a plug in the rear. Octal sockets have been used as the power connector. These are just about as universal and inexpensive as any connector tried. The base removed from an old metal tube makes a very good mating plug and conserves room at the end of the chassis because of its shallow construction. However many circuits will not be changed often and can use a small terminal board as tie points for power and input and output connections.

If you have imagination, like to build things the easy way, and in the process save time and money, we think that you will find the module system a useful approach at least for your experimental building. Whether you work phone, CW, or just listen, you can still MODULE-ATE. . . . W5WCF

K6BIJ
Box 143
Weimar, Cal.

The RK 715-B

a neglected tube



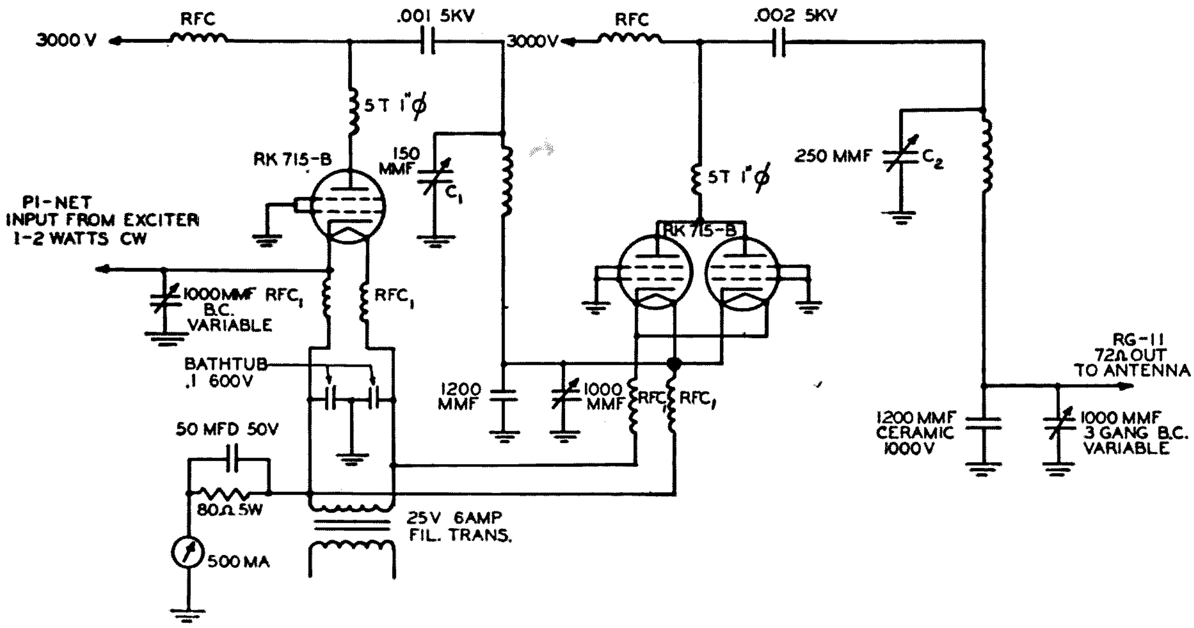
Heat dissipating connector for 715-B.

IT LOOKS LIKE 813, same size and shape, but has an indirectly heated cathode and four pins at the bottom going through a ceramic disc acting as a base. It is a tetrode, and an old Handbook (1949) says that its plate dissipation is 50 watts, filament voltage is 26-28 volts and you are supposed to run it with 1500 volts on plate at 125 ma and use 300 volts on screen. Sockets are readily available, and before surplus dealers see this article, the 715-B sells for about 50 cents.

The Handbook information looked fishy to me, so the following experimental data was obtained:

1. Three RK 715-B tubes in grounded grid (and screen grid) circuit can give you a legal limit on SSB or CW with 3000 volts on the plate and driven by Central Electronics 10-A exciter (its output tank changed to pi-network).
2. With sufficient convection—no cooling is necessary. Tubes will operate with dull red plates (when an Abe Lincoln heat dissipating plate connector is used).
3. Tubes operate normally on 25 volts (two 12v transformers in series). Raising the voltage to 28 volts did not improve matters. Filament current at 25 volts is under 2 amperes, which makes it easy to make filament rf chokes.
4. With grounded grids and pi-network used throughout (and all normal precautions like using a common grounding point), the rig is very stable on 80-40-20. It was not tried on 10-15 meters.
5. The amplifier is essentially a two stage affair, but if you do not hang any 6x4's or other unnecessary gadgets on it, the first tube will provide a considerable feedthrough power to the antenna, making it actually a three tube final.

. . . K6BIJ



Coil—conventional, from handbook. Pi-net condenser values shown for 80 meters, divide by 2 for 40 meters, by 4 for 20 meters. RFC-1—6v line filter choke from old car radio.

Report from the 73 Mobile

Jim Morissett WA6EXU

CONSIDERING THE NUMBER of mountain-tops and wide open spaces available here in the wild, wooly west, I decided to make use of the top of the 73-mobile for a roving antenna farm.

First a 6-element beam was tried from such peaks as Idylwild, Mt. Soledad in La Jolla, and various peaks around Los Angeles. With good results. The Heath Pawnee was used at all times.

But the real fun began when I discovered it was actually possible to mount a Master Mobile Twin-6 on top of the VW without exceeding the width of the rear vision mirrors, or a height of about 12 feet. That's when we started getting those "stoned" looks from passers-by. The same thing happened when the Space Raider P. D. Beam (16 elements) was tried, and when I later put both of them on at the same time—well, we developed something like prestige. Even the State police steered clear of us. I think they thought the white VW was from the AEC, or FBI.

(Turn page)

A total of 4000 miles was spent on west coast highways, startling the citizenry and racking up fabulous signal reports from various hilltops, using the gasoline-driven rotator shown in the photo. This climaxed with a trip to the Portland ARRL Convention, where we caused quite a stir, and the Seattle World's Fair, which was the only place we sort of fitted in with the scenery without causing undue comment.

Usually, in California, the reports on the Twin-6 were 5 to 10 db. above the P. D. Beam. This seemed about right, since all stations worked were using vertical polarization, the Twin-6 vertical, and only 8 of the 16 elements of the P. D. being vertical.

However, around Portland, those other 8 elements came in right handy, since I couldn't raise anyone at all on my two verticals (Twin-6 and Maynard "Kluge") but worked out just fine with the P. D.—Oregon & Washington being almost exclusively horizontal on 2.

The real corker came when I worked the San Diego net from about 60 miles out, about 200' above sea level. The Twin-6 was getting reports of about 1 and as high as 2 S-units over the P. D. Suddenly one station called and gave me a report of 35 over 9 on the P. D., and only 9 plus 20 on the Twin-6! Why? Instead of the usual vertical, this chap had a Spiral-Ray—nominally mounted in the vertical plane, but with elements skewed toward the horizontal on both ends. This did the trick, picking up on the diversity polarization effect from the P. D. Later another Spiral-Ray gave us a similar report. Since the P. D. is very new on 2 meters, no other stations were worked using P. D., but I expect this would have been more startling than the P. D.-to-Spiral-Ray effects. No "corkscrew" beams (helical) were found, either, but results should be similar.

We concluded from these tests that you sure do have to watch out for those trees, boy.

. . . WA6EXU

Book Reviews

KIAPA

HOW TO BUILD ELECTRONIC EQUIPMENT, a recent RIDER (#286) publication, is aimed at the ham who gains satisfaction from "rolling his own" gear. It begins with a chapter on tools and follows proper construction procedure of a typical project from chassis preparation to completion. The suggestions included in this book help avoid many of the pitfalls found in building your own equipment. Hardbound, 290 pages, $6.95.

HOWARD SAMS, HANDBOOK OF ELECTRONIC TABLES & FORMULAS would be a valuable reference book in any hamshack. Its 192 pages contain information that is usually found scattered throughout many texts. Some of the material included is not found in the more common electronic handbooks. Even a chart of the radio spectrum with FCC allocations is included. Hardbound, Catalog no. HTF-2, $3.95.

BASIC TRANSISTORS, by A. Schure, is another in the series of "picture-text" courses by RIDER. Starting with a description of the atomic structure of semiconductor material, it presents the theory of transistors and their fundamental circuits in an easy to understand sequence. Soft-cover, 146 pages, $3.95.

DESIGN AND OPERATION OF REGULATED POWER SUPPLIES is another well-written book by Irving M. Gottlieb. Typical open and closed-loop regulator circuits are examined. This text covers the use of both tubes and solid-state devices in regulated power supplies. HOWARD SAMS (RPS-1), soft-cover, 111 pages, $2.95.

Did you ever look at that piece of test equipment on your bench and wonder just what makes it tick? Are you trying to decide what test instruments would be the most valuable to you? **IT'S EASY TO USE ELECTRONIC TEST EQUIPMENT,** a new RIDER (#308) text by Larry Klein and Ken Gilmore will help solve this problem. This book not only answers these questions, but it shows some of the ways the equipment can be used. Soft-cover, 186 pages, $4.00.

A recent HOWARD SAMS publication, **GENERAL CLASS AMATEUR LICENSE HANDBOOK,** is primarily a book for the Novice who is "sweating" the theory for his General, Technician or Conditional ticket. Its object is to give the newcomer to ham radio enough knowledge to pass the requirements for a higher grade license, without becoming too involved in mathematics or complicated

discussions of radio theory. Soft-cover, 128 pages, $2.50.

GERNSBACK LIBRARY has printed a revised and enlarged edition of John T. Frye's **BASIC RADIO COURSE.** The popular first edition has been brought up to date by including material on transistors and other new devices. It presents a clear and concise picture of radio theory and is a good stepping-stone for anyone wanting a firm background in electronics. Soft-cover, 224 pages, $4.10.

HOWARD SAMS has just printed the fifth edition of their **TUBE SUBSTITUTION HANDBOOK.** This edition contains substitution information on American receiving tubes, including subminiature, industrial and picture tubes. A foreign to American and an American to foreign substitution section is also contained in this very handy text. Soft-cover, 127 pages, $1.50.

A B C's OF ELECTRONICS by Farl J. Waters, a HOWARD SAMS publication, takes a rather different approach to explaining the subject of electronic theory. The fundamentals are taught by analogies. Each new concept is related to something which is familiar to everyone. Soft-cover, 96 pages, $1.95.

QUESTIONAIRE

The below questions are arranged so you can cut out this part of the magazine. If you prefer your magazine uncut then just give your answers and the question numbers on a postcard or separate letter. Your expression of your interests will help us in the selection of articles for 73.

1) It is likely that I will be trying out six meter sideband during the next year. yes—— no——

2) It is likely that I will be going sideband mobile during the next year. yes—— no——

3) It is likely that I will be going to Europe with the Institute of Amateur Radio Ham Flight next fall. yes—— no——

4) I would like to see more emphasis on VHF in 73. yes—— no——

5) It is likely that I will be buying a tower this coming year. yes—— no——

6) I have purchased some surplus equipment during the last year. yes—— no——

Call —————— (not required)

Send this questionnaire or facsimile to
73, Peterborough, N. H.

The DX-40 with an SB-10

William Hall K1RPB
250 Mountain Road
North Wilbraham, Mass.

"Gee whiz, you must be kidding, Bill. I've never heard that combination used before. Whatever you did there, you've certainly got a clean, walloping signal here. Give me some of the lowdown. I've got a buddy next door with a DX-40; he'd like to get on sideband but says he can't afford it, hi!" This represents some of the enthusiastic, gratifying comments that have been received in contacts made on 75 thru 10 meters during the past year. To those wanting over-the-air circuit details, the basic conversation data supplied by the Heath Company is usually recommended. Unfortunately, this information does not include means of optimizing the compatability of these units into an integrated transmitting package. The interest expressed by many amateurs and the superb performance that is being displayed by the DX-40/SB-10 combination has prompted the author to write the following article.

Analysis of the project indicates that five basic steps are necessary to provide the operation suitable to most stations.

1) Construction of a good outboard power supply for the SB-10.

2) Placing the 6146 into class AB_1 amplifier service.

3) Installation of a switching arrangement to allow either sideband or normal CW/carrier control phone operation with the DX-40.

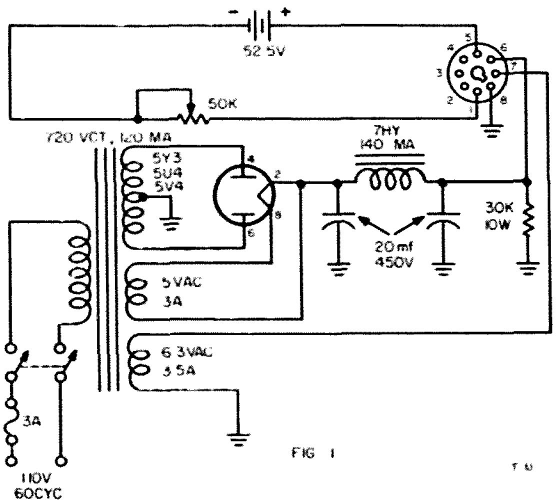


FIG 1

4) Routing excitation from the 6CL6 buffer in the DX-40 to the SB-10 and from the SB-10 to the 6146 grid in the DX-40.

5) Stabilizing the VF-1 VFO.

Power Supply

The circuit illustrated in Fig. 1 provides the necessary power requirements for the SB-10. It is relatively straightforward and will not be discussed in detail in order to save space. In addition, a -52 volt dc grid bias supply is required for the 6146 when it operates as class AB_1 amplifier. This is best obtained by connecting a 30 volt and a 22½ volt hearing aid battery in series and strapping these to the power supply chassis. A 50K potentiometer is series connected with the bias supply to allow a controlled amount of grid current to be drawn during tuneup. Since the grid does not draw current during actual operation, no power is consumed from the batteries and they will last approximately their rated shelf life.

Conversion of the DX-40

Two changes are made in the DX-40 circuitry. First, the RF excitation to the grid of the 6146 is broken at the output side of the buffer coils. This signal is routed through the switching arrangement to the SB-10 input. Signals from the SB-10 are then fed directly to the grid of the 6146 amplifier. Secondly, the 6146 is placed in class AB_1 operation for sideband service only. This is simply accomplished by the fixed -52½ volt bias battery pack and a regulated 210 volt potential on the amplifier screens. Again, these changes are routed through the same switching system. Now, the lowdown.

1) Mount two RCA type phono jacks on the rear chassis apron. If these are installed close together a small shield between the jacks is recommended to prevent undesirable coupling.

2) Install two OB2 voltage regulator tubes horizontally on the left side of the 6146 shield bracket located under the main chassis.

3) Install a three position, 2 wafer, 6 pole

rotary switch on the front panel between the bandswitch and pilot lamp. Do not tighten mounting nut. It may be necessary to move some of the power supply components in that area to make room for the switch and to prevent accidental contact after installation is complete.

4) Mount a 25K 10 watt wirewound resistor on a terminal strip fastened to the top of the chassis. This can be located in any convenient spot where heat dissipation will be good.

5) Remove the 110 volt antenna relay wire from pin 5 on the accessory socket and solder to pin 7 of same. Connect a wire from pin 6 on the AM-CW/SSB switch (deck 2) to pin 5 on the accessory socket. Similarly connect a wire from pin 9 (deck 2) of the switch to pin 7 of the accessory socket. This wiring change will allow the DX-40 to control the antenna relay for CW and AM and allow the DX-40 and SB-10 to control the same relay during SSB operation.

6) Remove the 27K 1 watt gril leak resistor between the rear deck of the bandswitch and the 20 ohm precision meter resistor. Remove the wire between pin 5 of the 6146 and the rear deck of the bandswitch. Install a 1.1 mh rf choke between pin 5 of the 6146 and the ungrounded side of the 20 ohm precision resistor. Loosen the front panel of the DX-40 and replace the ground wire at pin 6 of the grid/plate meter switch with a .001 mfd ceramic bypass capacitor. Now run a wire between pin 6 of this switch to pin 10, deck 2 of the AM-CW/SSB switch. Secure the front panel to the main chassis. Disconnect the grounded end of the 20 ohm precision resistor and connect it to pin 10 on the AM-CW/SSB switch (deck 2). Connect the 27K 1 watt grid leak resistor to pin 1 of the switch (deck 2) and the other end to the nearest ground point. Now run a wire to pin 12 deck 2 of the switch to pin 3 on the accessory socket. It is a good idea to bypass both ends of this wire to ground with .001 mfd ceramic capacitor. This completes the wiring of the grid bias circuits in the DX-40.

7) Connect a wire from pin 7 of the existing function switch to the 25 K 10 watt resistor previously mounted on the chassis. From the remaining end of this resistor, run a wire to pin 8, deck 1 of the AM-CW/SSB switch. Remove the wire between pin 3 of the function switch and pin 3 of the 6146. Install a wire between pin 3 of the function switch and pin 9, deck 1 of the AM-CW/SSB switch. Bypass pin 3 of the function switch to ground with a .001 mfd ceramic capacitor. Ground pin 7 of one of the OB2 voltage regulator tubes. Connect pin 1 of this tube to pin 7 of the second OB2. Bypass pin 1 of the second OB2 to ground with a .001 mfd capacitor and run a wire from pin 1 of this tube directly to pin 3 of the 6146. Connect a wire from pin 1 of the second OB2, around the front of the shield compartment to pin 6, deck 1 of the AM-CW/SSB switch. This completes the wiring of the screen voltage supply.

8) Disconnect the wire between the rear deck of the bandswitch and pin 5 of the 6146. Also remove the 47 mmfd capacitor between pin 5 and ground. Run a piece of RG58/U from the rear deck of the bandswitch to pin 2, deck 1 of the AM-CW/SSB switch. Similarly connect a piece of coax from pin 5 of the 6146 to pin 2 deck 2 of the switch. Ground the coax shield braid at both ends of both pieces. Connect a bare wire between pin 5 deck 1 and pin 5 deck 2 of the AM-CW/SSB switch. Connect a 62 mmfd silver mica capacitor between this wire and ground. Now connect a piece of RG58/U between pin 4 deck 1 of the switch to one of the phono jacks mounted at the rear chassis apron, grounding the braid at both ends. Mark this jack "out." Similarly run a piece of RG58/U between pin 4, deck 2 of the switch to the other jack and mark it "in." This completes the rerouting of the rf signal for the SB-

10 exciter. The use of a jumper cable to return the DX-40 to its normal AM/CW service is not required.

9) The following comes purely as a bonus. The author had made provisions several years ago to neutralize the 6146 final. Since this system robs drive and may have other deleterious effects in AB_1 operation, neutralization is switched in only during AM-CW operation. The neutralization "capacitor" is installed as follows. A feed-through insulator is mounted behind and to the right of the 6146, approximately one-inch distant. A stiff, 1½ to 2 inch wire is attached to the insulator above the chassis next to the tube. The wire is bent 90 degrees approximately ½ inch from its insulator end so that its main length is vertical to the chassis and so that it may be rotated about the insulator nut to vary its distance from the tube. On the underside of the chassis, connect a length of RG62/U (low capacitance coax) between the 20 mmfd drive control capacitor (hot side) to pin 1, deck 1 of the AM-CW/SSB switch. Similarly connect a piece of RG62/U between pin 10 of this switch and the under-the-chassis terminal of the neutralization probe feed-through insulator. It is only necessary to ground the switch ends of the coax braid. This essentially completes the conversion wiring of the DX-40 transmitter.

Adjustments

The length and type of coax (RG58/U) combined with the 62 mmfd capacitor at pin 3 on the AM-CW/SSB is found to give the best all around results after a great deal of experimentation. The addition of the cabling materially changes the resonance point of the buffer tank circuits, however. These must of necessity be retuned. After checking to make sure all the wiring is correct, plug in the DX-40, place the new switch in the AM-CW position, the function switch to tune and the bandswitch at ten meters. Pick a mid-range frequency on the band and adjust the drive control at half mesh. There may be very little grid current indicated on the meter. *With the power off* begin to remove one to two turns from the ten meter buffer coil at a time. A marked increase in grid current will be observed when the power is turned on. Continue to remove turns until grid current is maximized. Repeat this procedure for the 15, 20, 40 and 80 meter buffer coils. More turns may be removed at a time at the lower frequency bands. When this is completed, return the bandswitch to the 10 meter position and check the grid drive through the entire range of the band. If it is found to be less than the required 2 ma, replace the 27K 1 watt screen dropping on the two 6CL6 tubes with

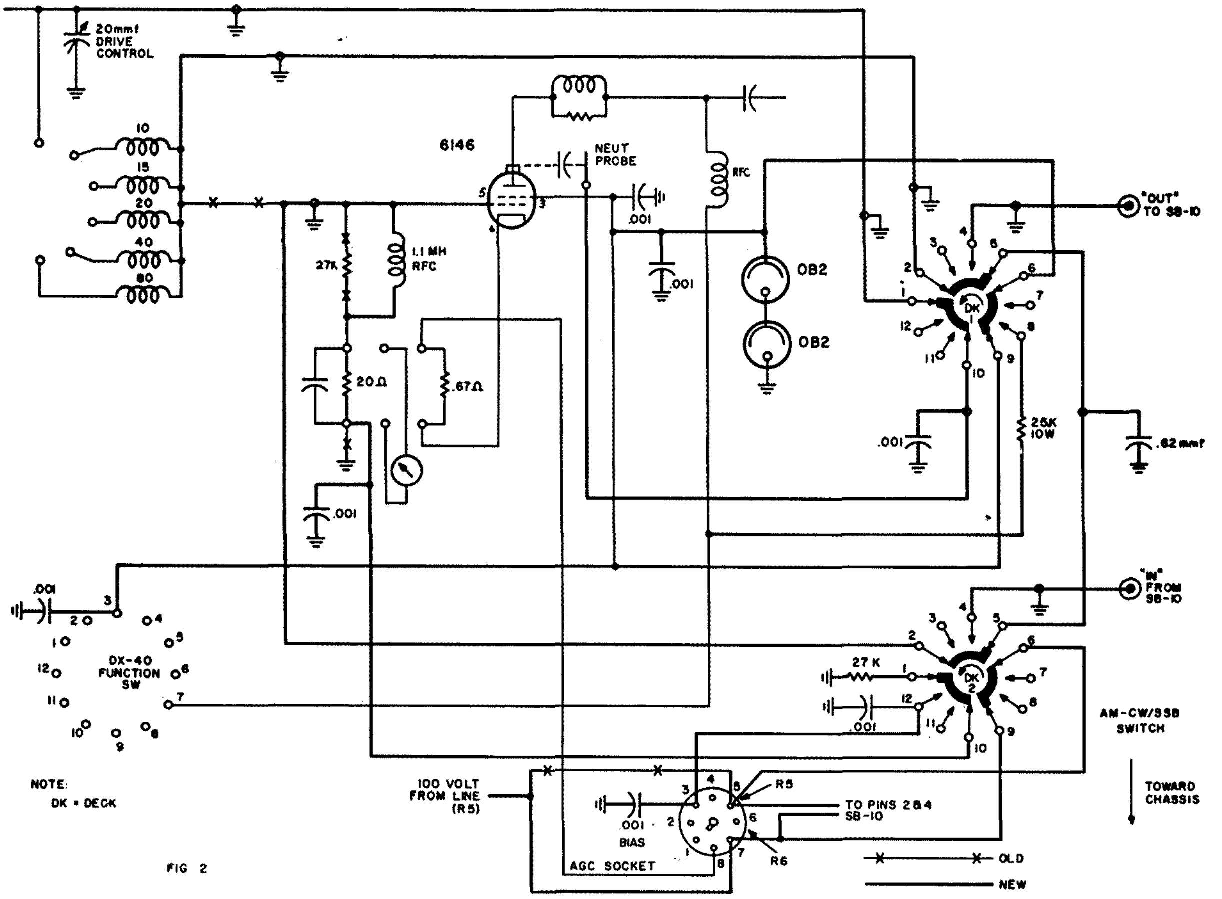


FIG 2

17 or 10K resistors. This should result in sufficient drive. 10K resistors are being used at the K1RPB installation without any apparent deleterious effects. With the grid drive set for maximum and the DX-40 in the tune, AM-CW, and ten meter position, slowly sweep the final tuning capacitor through its range. With the 6146 not neutralized properly, a dip in grid current will be observed. Turn the transmitter off or better, unplug it and loosen the neutralizing probe. Using an insulating object, vary the distance between the probe and the tube, repeating the "dip test" until the dip is minimized or completely eliminated. In carrying out this adjustment, "Danger-High Voltage" should be assumed. With the DX-40 unplugged, tighten the probe in its desired position. This completes the adjustment of the DX-40.

The SB-10 Hookup

The SB-10 is connected to the DX-40 in the following manner: 1) The antenna relay control wiring was removed from terminals 5 and 6 on the rear panel of the SB-10 and connected to pins 2 and 4 of its accessory socket. A three wire cable is run between the SB-10 and DX-40 accessory sockets. Wires are connected from pins 3, 5 and 7 of the DX-40 to pins 1, 2 and 4 at the SB-10 socket respectively. Pin 1 at the SB-10 has no internal connection and serves merely as a fastening point. Connect a five wire cable between pins 1, 5, 6, 7 and 8 of the SB-10 accessory socket and pins 1, 5, 6, 7 and 8 of the power supply socket (see Fig. 1).

2) A 14 inch length of RG58/U is connected between the "out" phono jack at the rear of the DX-40 and the input coaxial receptacle of the SB-10.

3) A 31 inch length of RG58/U is connected between the "in" phono jack and the output receptacle on the SB-10. These coax cable lengths are fairly critical for optimum operation.

4) The 47 mmfd silver mica capacitor removed from the DX-40 is now connected between the rf input receptacle inside the SB-10 and the coax leading toward the front panel of the adapter.

In many cases, the SB-10 is found to be unstable on 15 and 10 meters. This is easily cured by replacing the 2.2K 1 watt resistor between L_1 and pin 6 of the 6CL6 driver in the SB-10 with a 1.5K 1 watt resistor.

Stabilizing the VFO

For those using the VF-1 VFO with the DX-40 (as at K1RBP) the following steps are recommended to simplify operation and

increase stability. First, rewire the power cable to the station receiver instead of the DX-40. (Be sure to check if the receiver power supply is capable of handling this additional load). This results in the greatest stability improvement, as well as allowing the VFO to warm up in conjunction with the receiver prior to operation. The VFO is keyed by the transmitting relay external contacts to allow the oscillator to run continuously during CW operation, thus eliminating chirps. In order to do this, the white wire in the VF-1 cable is cut short and taped out of the way. Then a jumper wire is soldered between pins 1 & 2 on the VFO keying jack. It is now possible to spot the frequency by turning the operation switch to "on" (manipulation of the DX-40 function switch is now not necessary for spotting purposes). To complete the wiring changes, a piece of coax is run from the transmitting relay to the keying jack on the VF-1. Connect the VF-1 output to the DX-40 and place the transmitter in the "tune"—"10 meter"—"AM-CW" positions. The VF-1 will be in the 40-20-15-10 and "on" positions. Insert a key in the DX-40 and obtain maximum grid drive. Tune in the signal with the BFO on. Key the transmitter. If there is any frequency shift, detune the VF-1 output coil until there is no difference between the key up and key down notes. Repeat this procedure on 40 meters using the 160-80-40 position on the VF-1. After a ½ hour warm up period, place the VF-1 in the 40-20-15-10 position and turn the switch between standby and on. If there is a short but rapid drift observed, replacement of the 6AU6 is recommended.

Testing

With the DX-40, SB-10 and VFO properly cabled together, the following procedure for testing is suggested.

a) Connect a 60 watt dummy antenna to the DX-40.

b) Turn the AM-CW/SSB switch to the AM-CW position and test these functions as outlined in the instruction booklet.

c) Switch the DX-40 to standby, the AM-CW/SSB switch to SSB and plug in the keying cable from the SB-10. Turn the SB-10 power on, and match the bandswitch positions on both units.

d) Disconnect the output cable from the SB-10 to the DX-40 and switch the SB-10 to "manual" and the DX-40 to "CW" on the function switch. Plate current should read approximately 25 ma.

e) Place the DX-40 and SB-10 on "standby" and reconnect the output cable of the latter to the transmitter. Now turn the DX-40 to "tune" with the meter switched to the "grid" position. With the series variable resistor in the bias battery string set for maximum resistance turn the SB-10 to "manual." Tune the DX-40 drive control and SB-10 tuning controls for maximum SB-10 output. There should be next to no grid current indicated at the DX-40. Carefully decrease the bias series resistance until about ½ ma grid current (never more!) is drawn by the 6146. Switch the DX-40 to the "CW" position on the function switch, and the meter switch to read plate current. Quickly resonate the final to 125 ma. Turn the adapter output control counterclockwise until plate current just starts to drop off. Grid current should now be zero with full loading on the amplifier. Null the carrier. Speed is of essence in the tuneup of the final since the tube is operating past its maximum plate dissipation rating. With modulation the plate current "kicks" must never exceed 100 ma.

Sideband is loads of fun. There's little reason why it can't be enjoyed by every fone man who is contemplating permanent QRT due to heavy AM QRM. Even the dyed in the wool CW man is becoming fascinated by this effective mode. The proof of the pudding is in operating the DX-40/SB-10 on 75 meters on Sunday nights and getting the following comment: "Gee whiz, OM, you must be kidding . . ."

. . . K1RPB

How to Build a Junk box

W. G. Eslick
2607 East 13th Street
Wichita 14, Kansas

Newcomers to the amateur fold with limited resources overlook a lot of good bets in getting 'goodies'. A few examples. Older auto radios of 8 to 10 years age have very little resale value. Radio shops, used car lots and junk lots will usually give these away or ask very little.

The speakers with a six volt field coil (not a PM) yield lots of wire (around #22 to #26). Even the hash chokes (#14 to #18) make good coil wire.

Audio output transformers designed for 6V6's or 7C5's will work with 6AQ5's. A push pull output transformer will make a good modulation transformer, using the *ct* for B+, one plate lead to a 6AQ5 (6V6) modulator and the

other plate lead to the rf load. The speaker leads would not be used. The primary of audio output transformers with a dc resistance of 200 to 500 ohms can be used as filter chokes in small power supplies running around 50 ma. or less.

Don't overlook the fact that by stripping the power supply from a good auto radio, adding a small ac supply and using a mobile converter, a good home SW receiver can be had.

Old TV sets are a mint of supplies. Power transformers with a husky current output, filter chokes, audio sections, a good supply of resistors, tube sockets, slug tuned coil forms, wire from width and liniasity coils, rf chokes, to mention a few, plus oodles of tubes. There has been several articles on making good front ends from a turret tuner for your homebrew communications receiver. A uhf converter usually can be made to tune the 420 mc ham band.

If there are any electronic plants in your area, don't overlook the local junk yards. They buy the junk from the plants and there oodles of electronic parts may be had for as low as five cents a pound.

Get acquainted with the maintenance men of hospitals, office buildings and big concerns. Old intercoms and many other goodies may be laying around, many times yours for the asking. Motor rewinding shops are a source of cheap wire of all sizes to wind your coils.

Make the rounds of radio-TV shops. Some will give you old sets to 'clean house' and others will sell you bargains.

Don't overlook any business in your town that takes 'trade ins.' Some radios and TV's are not worth the repair in order to resell them and they must get rid of them. I have seen many an old TV set that could be bought for one to three dollars.

Used car dealers (auto junk yards also) are good bets for used car radios.

There are many sources not mentioned that may exist in some parts of the country and not other parts. It doesn't take long for word to get around among hams that so and so's salvage has got some good stuff in. Just look and listen. Don't go overboard and pay too much for used units. Mentally think what can be salvaged and what the same items would cost you new and come up with an idea of what it's worth to you.

Don't ever forget that 'dealers' are out for a buck. If they see you want something badly they may ask five dollars for it. Someone else not so anxious gets it for fifty cents to a dollar. I have seen this work many a time. Don't overlook the idea of club auction and 'buy, sell or swap' in club papers.

This has been written for the novice or beginner who is starting to build up a 'stock.' A ham can usually fill a garage or basement with 'junk' for the same price that a novice can fill a cigar box with parts. Get going and good luck.

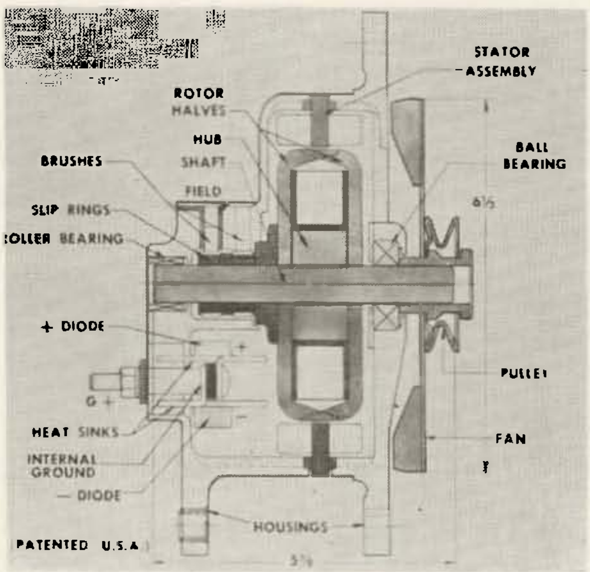
Mobile Alternators and Alternator Conversions

Floyd O'Kelly W5VOH
418 East Hickory
Midland, Texas

WITH THE INTRODUCTION of more and more high powered AM and single sideband mobile transmitters and transceivers, the strain on the factory-installed electrical system of the average automobile has almost reached the saturation point. Even the highly efficient transistor power supplies require more power input than is realized in the output. We are reminded of the old adage, "You can't get something for nothing."

Mobile alternators have provided a convenient way to increase power and eliminate the problems of battery failures and poor operations resulting from low battery voltage. So let's examine the alternator from two angles—first the alternator itself, its function and operation; second, its conversion from six volt to twelve volt operation.

Mobile alternators produce low voltage, high current, three phase ac power. This power is rectified, regulated and used to charge the battery and supply power to operate the electrical components installed in the automobile. From the standpoint of efficiency, this



Cross-sectional drawing of Leece-Neville 6000 Series, 40-ampere alternator, used in most passenger cars.

system beats a generator, hands-down. At engine idle (about 500 rpm), output of a small (40 amp rated) automotive alternator is about 10 amperes. A comparable generator has not even cut-in at this speed. The vehicle must be traveling 15 to 20 mph in order to charge the battery. The output of an alternator rises much more rapidly with the engine speed than does the generator.

In terms of performance, an alternator can produce more electrical power over a wider engine speed range than a generator. In most cases, more electricity to power all of the normal vehicle's lights, accessories, and mobile equipment is delivered at engine idle.

Now that we have examined a few of the alternator's advantages, let's take a peek at the innards of this mysterious package and see what makes it percolate. Most of us are familiar with the conventional generator's function, so let's use a comparative analysis between the generator and the alternator. The main functional parts of a generator are the armature, field coils and pole pieces, commutator and heavy current-carrying brushes. The field coils and pole pieces produce lines of force, known as the "field." The armature, which is the rotating member, cuts lines of force, thereby inducing an ac voltage in the armature windings. The commutator and brushes mechanically rectify this ac voltage into dc required by the vehicle's electrical system.

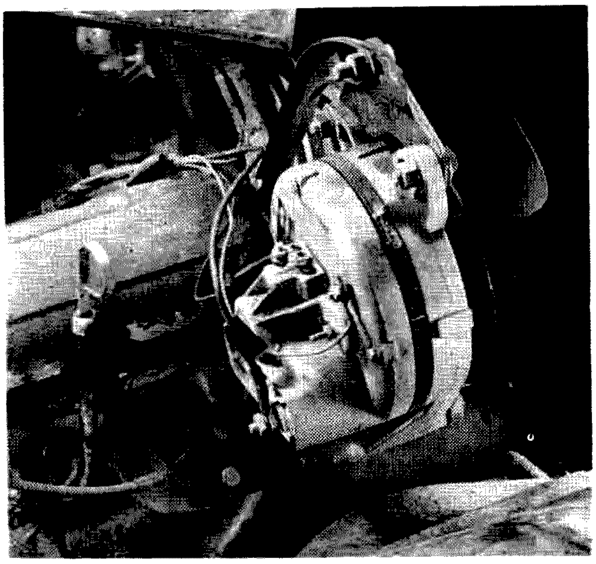
The main functional parts of an alternator are the stator (this compares functionally with the generator's armature); the rotor (functioning as the field coils and pole pieces); and the rectifier (which performs the same duty as the commutator and brushes). The stator, from which the electrical current is picked up is stationary; the field revolves within it. Or, stated another way: the stator is the stationary member of the alternator, just as it is in a conventional ac motor—but, its function is different. In an alternator, the *rotor* produces the lines of force. As these lines of force cut

the stator windings, a three-phase ac voltage is generated. This voltage is conducted to the rectifier unit, which electrically changes the ac to usable dc. An alternator can be thought of as an "insideout" generator that produces three-phase alternating current.

If you ain't "seen the light" yet, let me throw a few more alternator advantages at ye: since the stator conducts the high output current, it is not necessary to use large brushes; more windings can be inserted in the stator slots to give a greater electrical output than from a dc generator of comparable frame size; also because the stator is stationary, the windings are not subjected to centrifugal force as in a generator; the rectifier unit changes the ac to dc *electrically,* so does not encounter mechanical wear as do the generator's commutator and heavy brushes; maintenance is much lower on alternators than on generators (for one thing, the alternator has no commutator or cumbersome brush system—slip rings and bearings are the only wearing parts. The slip ring brushes seldom need attention since they only carry the 2.5 amps required for field excitation). The heavy current load common to brushes and commutators of ordinary generators is taken directly from the stationary member of the alternator.

The Leece-Neville Company of Cleveland pioneered automotive type alternators for the armed forces during World War II. They released them to police, fire and governmental vehicles as soon as wartime production ceased. Most FBI, state and local law enforcement agencies, and fire departments now use alternators to the total exclusion of generators. You may recall first reading about alternators back in August 1945, when a B-25 crashed into the 83rd floor of the Empire State Building. A New York City police cruiser, with its engine idling, was used as an emergency communications relay station until more elaborate facilities could be set up. With a Leece-Neville alternator supplying all the electrical power for its radio, lights and other accessories, the cruiser stayed on the scene in continuous operation for 36 hours after the tragedy.

Alternators are now priced competitively with comparable generators. When first introduced, they cost $20 to $100 more than generators of comparable ratings. But, even at that price, they reduced associated costs such as battery replacement and ignition system maintenance so much they have proven to be actually less expensive than ordinary generators in the long run and so have even more to offer the average car owner—especially the ham operator with a mobile rig. For instance,



Typical installation of Leece-Neville 40-ampere, 6000 Series alternator with built-in silicon rectifier diodes.

reports retained by Leece-Neville show that battery life has increased anywhere from 30% to 100% as a direct result of installing alternators to replace generators. Even without preventive maintenance or extensive repairs, the average alternator system can be expected to give three times the service life of conventional dc generators.

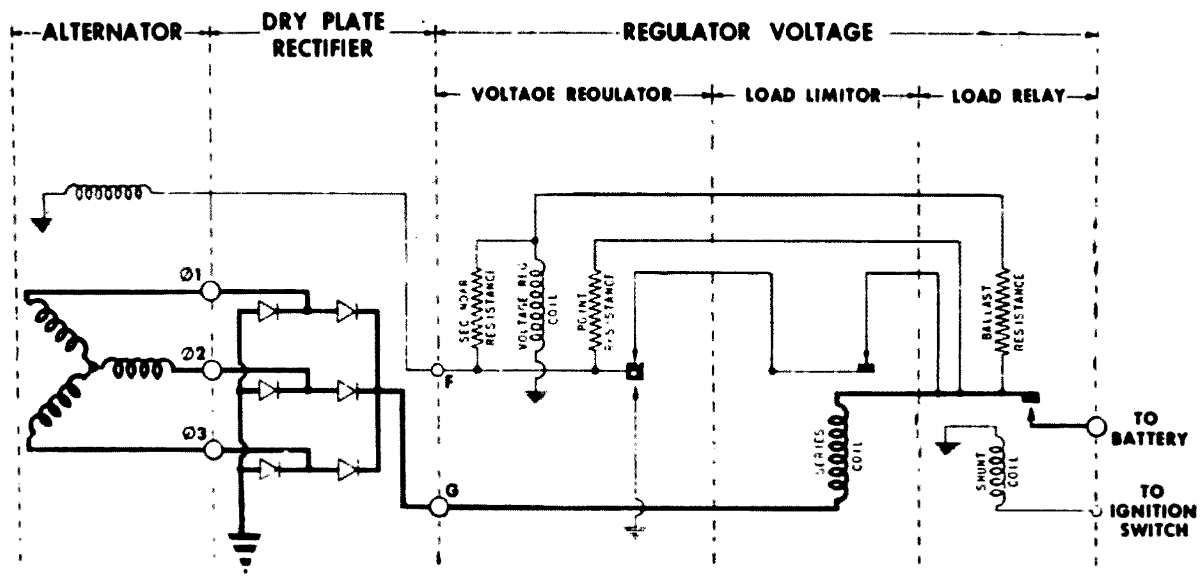
If you are contemplating the purchase of a new family 'bus,' you should consider either placing an alternator system under the hood yourself or checking with your dealer and have the system factory installed in place of the conventional generator.

Unfortunately there are a few of us that can't quite swing the price of a new unit and must resort to the timely art of conversion. With the influx of twelve volt systems on almost all of the new cars there are many six volt alternator systems being placed on the shelf. The price of these units usually depends on the power rating and of course on its condition. One of the most popular six volt alternators and the one that will probably be found by most of us scroungers is the Leece-Neville 5058-G Series, rated at 95 amps. So for the sake of an example, we will refer to this series in our conversion discussion. All parts mentioned may be purchased from your nearest Leece-Neville sales center, or ordered through the Leece-Neville dealer in your community.

Let's assume that we are going to convert the 5058-G series alternator to a 12-volt, 50 to 60 amp unit and require a high (20 to 30 amp) output at engine idle. The first step is to remove the rotor assembly from the alternator. Second, install a new rotor coil No. 28459 and a two turn stator No. 32641. If a high output at engine idle speed is not required, you can convert the alternator simply by changing only the rotor coil. Another alternate is to completely replace the rotor assembly (Leece-Neville No. 29802). This will increase the overall conversion expense and will probably not be considered unless the original rotor assembly is damaged. You do not have to touch the stator in this method of conversion.

Unfortunately the alternator is only a portion of a system that also contains a regulator and a rectifier. At present there is no method of converting them. However, the required regulator and rectifier may be obtained from any Leece-Neville distributor.

Another option on the conversion process is to install silicon diode rectifiers in the alterna-

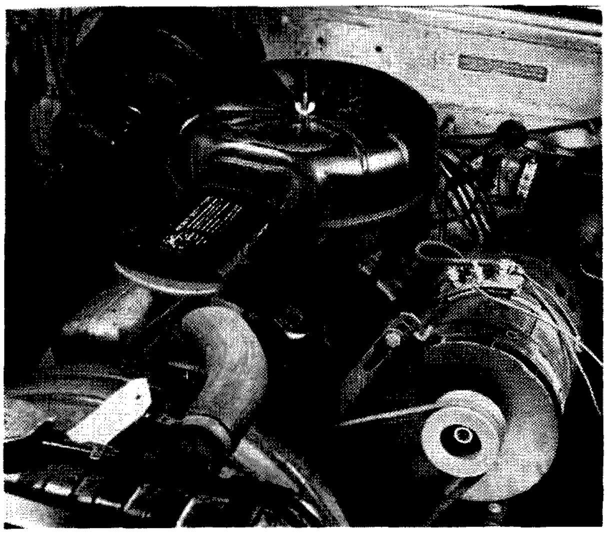


Complete wiring diagram of the negative ground system. The positive ground system is identical except that the diode connections going to terminal G and those going to ground are reversed.

tor. This may be accomplished by using the Leece-Neville rectifier kit number 57254. The kit consists of a new alternator end housing with built-in silicon diode cells, heat sinks, housing cover, and connection cables. You merely take off the old end housing and replace it with the new silicon rectifier end housing unit, using the original through bolts and ac stator terminal nuts and washers.

If I have sold you on the alternator and you are ready to have one installed or install one yourself (either from preference or because you happen to be as broke as I am) you may be interested in a few notes on installation and trouble shooting.

When installing an alternator system disconnect the battery first and do not reconnect until you are ready to check the installed system. Be sure to check the ground polarity and see that your rectifier and regulator system are corresponding polarized. If you hook up the battery or rectifier backwards, you'll be causing a short circuit across the battery, to say nothing of ruining those gold plated diodes.



Typical installation of Leece-Neville 60-ampere heavy-duty alternator equipped with silicon rectifier diodes.

It would be impossible to be specific on the physical installation because of the many different makes and models of cars. However, there are available complete mounting kits for your automobile from the Leece-Neville Company that furnishes just about everything except the fan belt. Just use your hat rack coupled to some common sense.

After the installation a few simple checks can be made to determine if the alternator is functioning properly; with the engine at idle speed, remove the "F" (field) lead from the regulator, and touch it against the "G" (ground) terminal. This will allow the alternator to operate "Full Field."

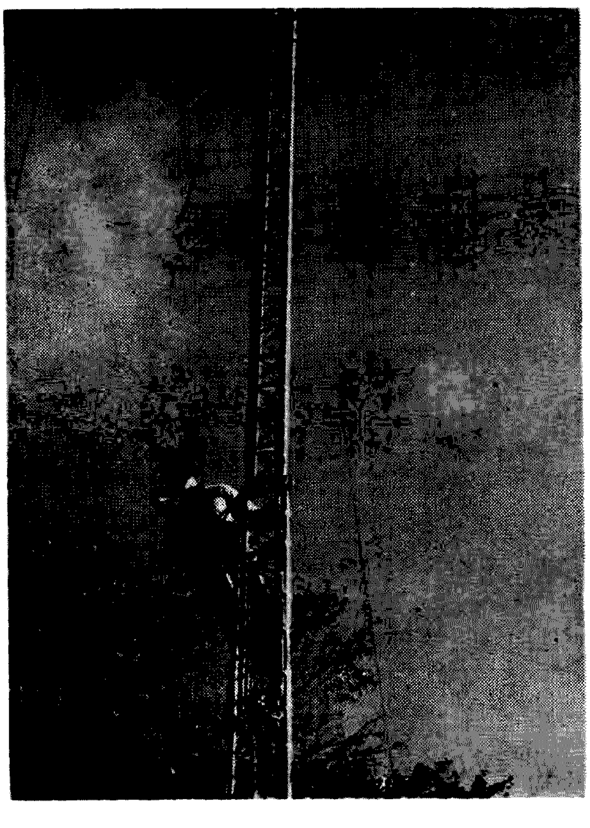
If the alternator shows a high rate of charge when running full field, the alternator is functioning properly. If the alternator shows a very low or no rate of charge when running full field, the alternator will have to be removed and checked on the bench. Remove the rotor from the housing and check with an ohmeter to determine if it is open or shorted by placing the meter's leads on the slip rings to measure the resistance of the coil. The meter should read between 4.3 to 4.6 ohms on a 12 volt, or 2.3 to 2.5 ohms on a 6 volt system. If very little resistance is read, it indicates a possible shorted coil. Check for loose or broken wires at the slip rings. If infinity is read on the meter, the coil is open. If the rotor checks good, it should be cleaned by washing with a brush dipped in a cleaning solvent or paint thinner. Rinse with another brush dipped in unleaded gasoline or kerosene and wipe dry with a cloth.

While the unit is on the bench, check the stator sections for continuity between each section and ground (these leads should be disconnected from the rectifiers). Next check for continuity between each stator phase, then check for ground between the stator leads and the stator. Continuity should be found in each combination.

Many amateurs will discover the advantages that the alternator system has to offer and will probably bend your ear about them every time a discussion starts on mobile operations. Two important features that have not been discussed are: 1. The noticeable absence of generator noise that is usually so aggravating on the higher frequencies; 2. The alternator produces a three phase ac voltage that can be utilized directly into a transformer system to supply just about any voltage that you might need. Three phase power supplies offer better transformer utilization, less ripple output and better power factor in the load placed upon the ac line. Only a small amount of filtering is required on such a power supply and the battery is not overloaded.

So the next time the snow is near the sensitive area of a tall giraffe and your car won't start, or your transmitter starts "FM-ing" because of a low charged battery you will be only one step away from becoming a proud owner of an alternator. . . . W5VOH

73 trys out the Viking Personal Messenger



WHILE I FIND the doings on the Citizen's Band as annoying as any other amateur, this in no way interferes with my using the band for its intended purposes. I don't believe in letting a little emotion stop me from being practical.

The 11 meter band comes in handy for ham use every now and then, though not for hamming. For instance, the Porsche Club was putting on an acceleration test and needed communications between the start and finish to time the runs. We could have done it by ham radio to be sure, but by using a couple of CB handitalkies we were able to let anyone available operate the rigs and the event went off very smoothly.

Speaking commercially, there is a wide choice of pocket sized CB gear and nothing much for the ham bands. Sure, I could retune

the gear to ten or six meters without much difficulty, but this would lower the utility because then I could only use it with licensed operators at both ends and though most of my friends are hams, I do have a slight circle of acquaintances in other fields. Why restrict their use when there is little to be served by doing this?

We keep a pair of handitalkies around here ready to use and find them invaluable. When someone is making the trip up one of the 100 foot towers it is a lot easier to have him clip a rig on his safety belt and keep in touch with him instead of trying to holler over the wind and traffic noises.

The units also come into play when we have some antenna tuning or evaluation. We park someone on a neighboring hill with a field strength meter and the CB unit and tune away. It also is dandy for investigating TVI complaints, greatly speeding the process of trying all bands and beam directions while maintaining constant communications during the process.

We have a friend (non-ham) who goes hunting a lot and he has found the units a great help for keeping in touch with fellow hunters and keeping them from shooting each other.

When we decided to invest in a pair of CB handitalkies we looked over the market very carefully. The final choice was a pair of the Johnson Viking Personal Messengers. This decision was dictated by the high power that they put out (one watt) and the available rechargable battery assembly. The extra range made possible by the one watt unit over the more usual 100 milliwatt or less frequently is important. The lower power transceivers are less expensive and don't require the formality of even a CB license, but the higher power, when you need it, is worth all the extra effort and expense.

. . . W2NSD

Station Time Panel

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BACK IN THE "good old days," when exact timing was not too important, the "station chronometer" was a 98-cent alarm clock, which was wound daily (if we didn't forget); and set, every now and then, by the NAA time signal. This gave us a time standard of sorts, which was usually within five minutes, plus or minus, of "train time."

With the passage of years, time became more important, and now, in many instances, time accurate to about the nearest second is very desirable. RTTY transmissions start exactly on schedule, and are not repeated. If you tune in late, you lose the first part of the transmission.

With the increasing importance of accurate time, the 98-cent alarm clock was replaced by a better mechanical clock, and later by an electric clock, which kept "perfect" time between the almost-daily power failures. For this electric clock, an "automatic" WWV setter was developed, as well as a power failure indicator. Eventually, the electric and mechanical clocks, and all the various adjunct "black boxes," took up too much desk space, and the desirable and tested elements of the assemblage were integrated into a single time panel, appearing as in Fig. 1.

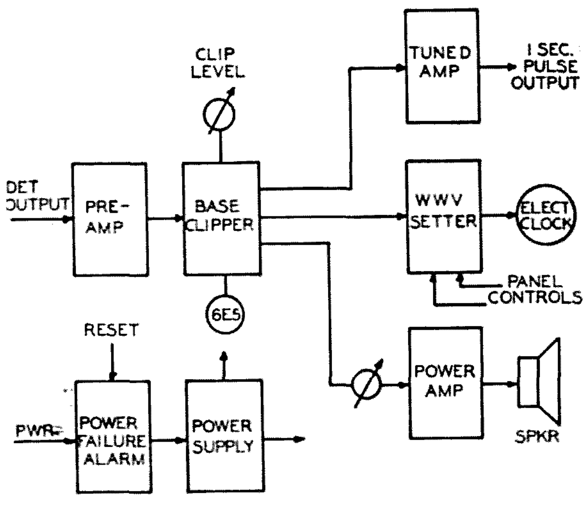

Fig. 2

For operating convenience, the mechanical clock (right) is kept on Greenwich Meridian Time ("Universal Time"), and the electric clock, (left), which is periodically checked against WWV or WWVH, and reset when necessary, is kept on local time. This procedure eliminates mental calisthenics in converting from one time to another, yet makes possible immediate recovery of local time should the power fail (as it too frequently does).

Block diagram of the time panel comprises Fig. 2. Circuit of the "ordinary audio" portion, which is largely conventional in design and use, is shown in Fig. 3. The detector output of the receiver is fed into a pre-amplifier, which is one half of a 12AT7, conventionally connected and operated. Pre-amplifier output goes to a base clipper, which is adjustable to eliminate background noise. Signal and background levels, at the output of this, are monitored by use of a 6E5 "Magic Eye" tube. Base clipper output also goes to a 12AT7 cathode follower.

From an adjustable tap on the load resistor of this cathode follower, a signal is fed to a 6AQ5 power amplifier, and thence to a small speaker on the panel. Speaker output is the input signal, amplified and stripped of all, or any desired part, of the background noise.

Fixed output of the cathode follower goes

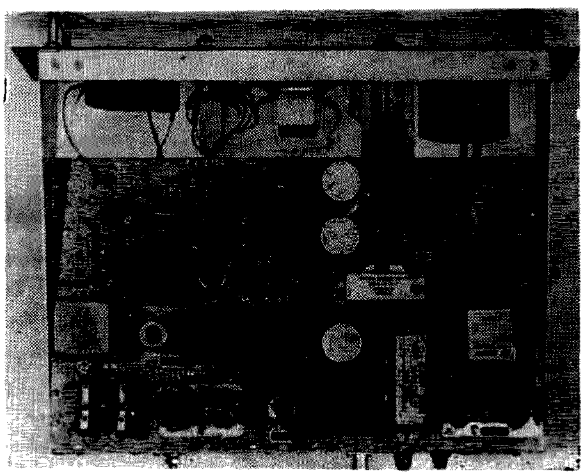

Fig. 4 Above-chassis interior view of time panel.

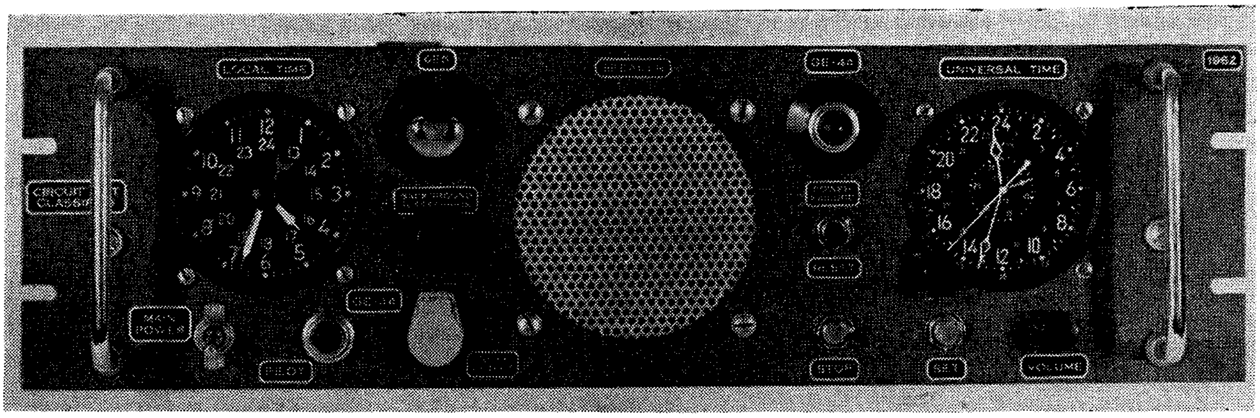

Fig. 1 Station time panel.

to the "automatic" setter for the electric clock, and to a selective amplifier, whose output is the "seconds pips" of the WWV signal. Major components of this audio channel are visible near center of Fig. 4.

The selective amplifier, which isolates the seconds pulses from the composite WWV signal, is an "MIT" design[1], using the two halves of a 12AU7A in cascode as the amplifier, and a twin-T network as the frequency-selective feedback element. A 6C4 cathode follower isolates the feedback network from the amplifier, and also provides an isolated output.

Circuit of this amplifier, with constants, constitutes Fig. 5. To eliminate the use of costly precision components, the resistive elements of the filter are made adjustable. Exact values of these components can be computed from standard handbook formalae, or scaled from the Carter Nomograph[2].

After construction, the filter is set to approximately 1,000 cycles, and then trimmed to exact setting using the WWV signal as a standard. The adjustments are the two "Frequency" controls visible in Fig. 4. Almost any symmetrical dual triode will perform well in this circuit.

The clock setter is a signal-actuated switch, and is an improvement of an older model which performed well. Circuit of this comprises Fig. 6. Under normal conditions, the armature of the set coil of the symmetrical latching relay is up, the clock is connected to line, and keeps as good time as the local frequency stability permits.

When clock time differs from WWV time, the second hand is stopped at 60 by pressing the STOP pushbutton, and the minute and hour hands are manually set to the next WWV announcement period. Pressing the STOP pushbutton energizes the set coil of the latching relay, which disconnects the clock from the line (stopping it); shunts the power switch of the entire panel, and closes the contacts

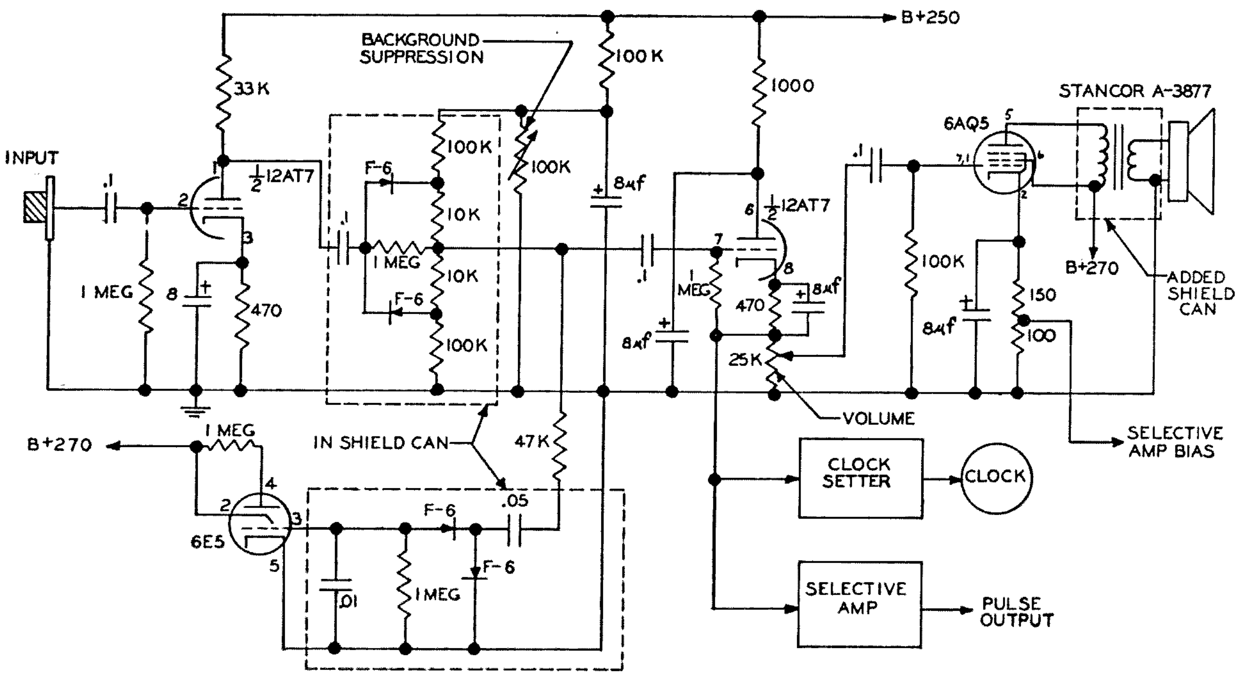

Fig. 3

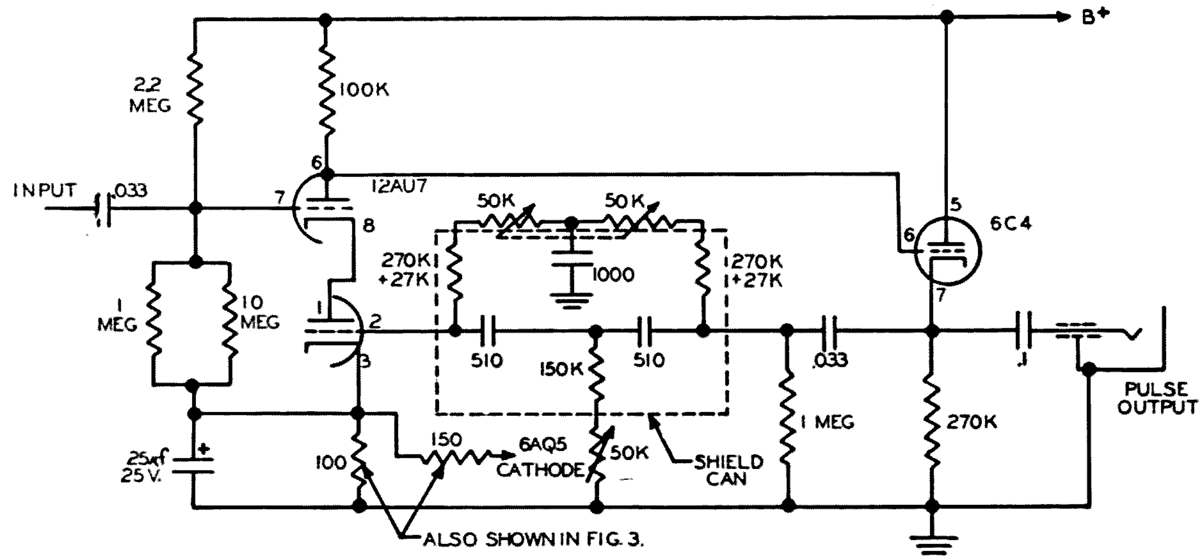

FIG. 5

associated with the reset coil of the same relay. As this is a latching relay, the coils only draw current when energized, but the contacts "stay put" until the opposite coil is energized. The F-6 diodes across the relay coils, "connected backwards," are flyback absorbers.

After the second WWV time announcement of the next period, the SET pushbutton is depressed. This readies the circuit for the commencement of the tone signals. Pressing the SET button energizes the DPST relay (extreme right, Fig. 6), which is wired for self-holding (lower armature contacts), and which also energizes the reset coil of the latching relay. This relay, however, cannot function, as no signal is incoming, and the right half of the 12AU7A is held to nonconduction by the Zener voltage on its cathode.

Recommencement of the WWV tone signal applies an af voltage to the system. This is amplified in the left half of the 12AU7A, rectified in the doubler circuit between halves of the tube, and the rectified output applied to the right grid. This drives the tube into conduction, so that the reset coil is energized, and its armature pulls down. This releases the previously locked-down armature of the set coil, so that the clock starts, and the shunt is removed from the panel power switch. At the same time, the contacts controlled by the reset coil armature are opened, removing energization from the DPST relay. After a short time

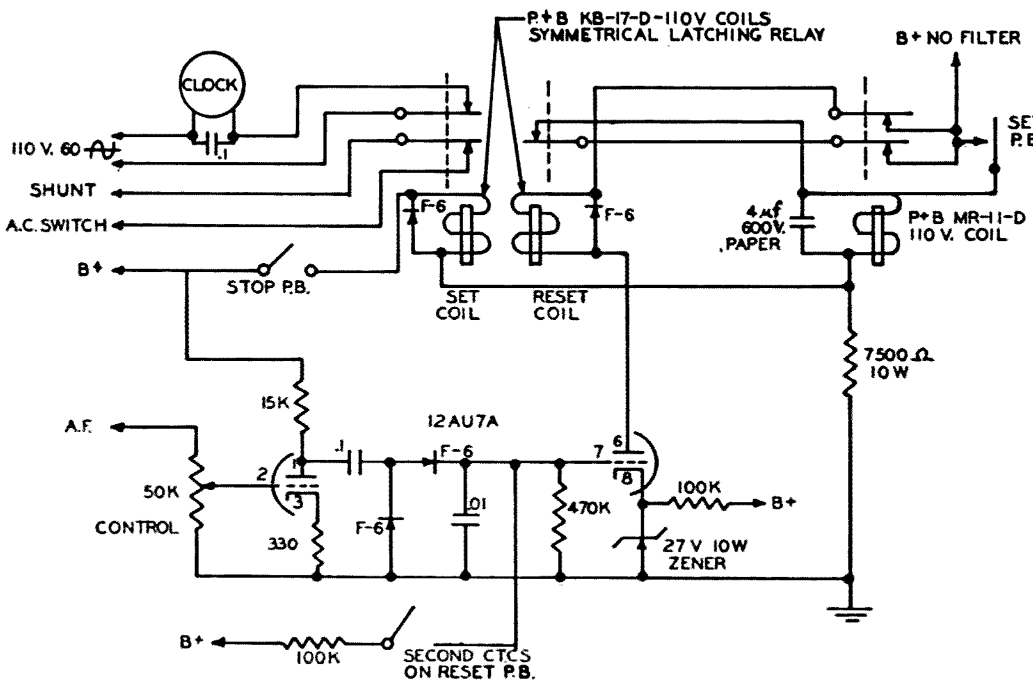

Fig. 6

delay, caused by the 4 mfd shunt capacitor, the armature rises, de-energizing the reset coil of the latching relay. This time delay is inserted here so that the armature of the reset coil will surely pull down and latch in place before the coil is de-energized.

If desired, the amplifiers and reset mechanism of this time panel can be made to shut itself off automatically once the clock is set. This is made possible by the contacts on the set coil that are shunted across the ac switch. For automatic shutoff, snap the main power switch to OFF position any time after the STOP pushbutton is depressed.

If there is a fumble or snafu anywhere in the setting process, press the SET button and then the RESET button, and everything is ready for a new start.

Components of the clock setter are visible in lower left of Fig. 4, and in lower right of Fig. 7. Note the copper disks which form the heat sink for the Zener diode.

Power supply used is somewhat more than adequate, with an ample margin of safety built in, to avoid trouble as components age. Circuit of power supply and power failure alarm comprises Fig. 8. The power failure alarm is a self-holding relay, which releases when the power is interrupted, and must be manually reset (RESET pushbutton). In its de-energized position, the relay switches an alarm light on. This is a GE-44 bulb, operated from the line in series with 5 mfd of capacitance.

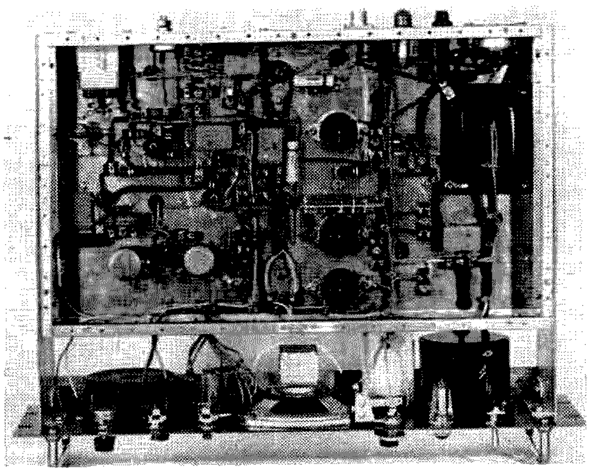

Fig. 7 Under-chassis view of time panel.

Layout and construction are not at all critical. Components that must be seen regularly, or operated regularly, are placed on the front panel. Adjustments of the "set and forget" type are mounted on the chassis top and skirt. Permanent connections—ac and audio input—are made at the rear; the temporary connection—Pulse Output—is made by means of a jack on the front panel.

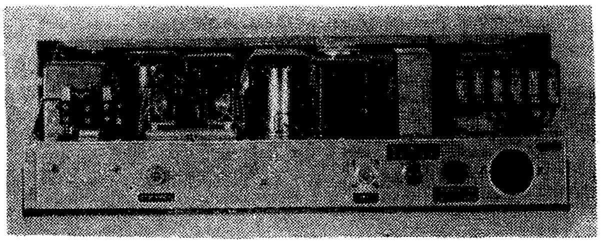

Fig. 9 Rear Chassis skirt of time panel, showing inputs and "set and forget" control.

Workmanlike construction is most desirable, as a time panel of this type is designed for regular use, not as a repair and trouble–shooting exercise. Liberal use of tie points (Fig. 7) not only firms up component mounting, but also provides convenient test points, so that a component failure, if one occurs, can be localized promptly, and corrected without performing major surgery on the assemblage.

Mounting of the various networks, most of them in shield cans, is simplified by use of punched epoxy board and push-in terminals (Vector 82G24WE and T-28, for example). Cabling here is done by use of G-C cable ties.

Initial adjustments are few and relatively simple. After a thorough circuit check, feed a WWV signal into the input. In the writer's receiver, this is taken from the detector output through a cathode follower. Set background suppression to zero, and adjust speaker volume to suit your taste. Slowly advance the background suppression control until the signal has optimum intelligibility. This will be at approximately the point where the 6E5 is wide open on no signal, and closed, or slightly overlapping on receipt of an audio signal. Readjust the volume if necessary.

Set the CONTROL (rear chassis skirt, Fig. 9) at about mid range, and go through the clock setting procedure, readjusting, if necessary, to secure certain operation of the relays. None of these adjustments are critical. Lock the CONTROL when operation is satisfactory.

Adjustment of the selective filter for the pulse output is done as follows:—Feed a signal of as near 1,000 cycles as possible into the time panel input, and adjust the frequency controls (upper left, Fig. 4) for maximum output. Then, replace the 1,000 cycle source with a WWV signal, and gently re-adjust these same controls for maximum pulse output. When this is attained, lock the controls.

Performance of this time panel has been entirely satisfactory, with maintenance needs confined to replacement of one pilot lamp in six months. The predecessor of this device, using the same general principles, but somewhat cruder circuitry, became obsolete after five years of service with no need for any major repairs.

A considerable number of alternative circuits and layouts, performing the same functions, are possible, and should perform well. The only precautions to be followed, and these are for operating and maintenance convenience only, are to make components possibly needing attention accessible—the silicon rectifiers should be near the back of the chassis and exposed, so that they can be tested and replaced easily. The filter capacitors are best

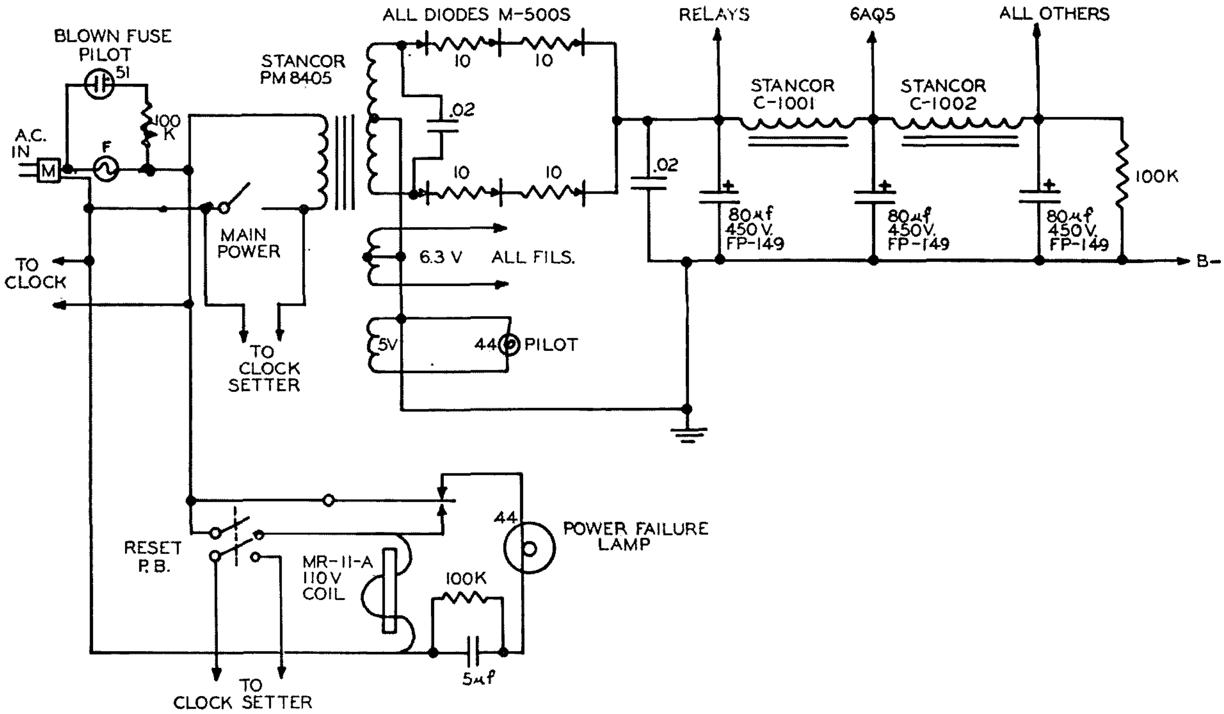

Fig. 8

socket-mounted (Cinch 2-C-7), for easy replacement. The relays should not be "buried," as the contacts may need cleaning after several years of service.

Although almost any electric clock, and almost any mechanical clock, can be used on this panel, fairly rugged equipment is most desirable, so that indicated time will mean something. The electric clock used is a Navy type, with cut gears and heavy plate construction, suggesting long trouble-free life. The mechanical clock is a Waltham Aircraft Chronometer. This is available surplus, in running condition, for about $20.00 (C and H Sales); used, but reworked and with an FAA certificate, for about $85.00; and new for about $125.00. This clock, in station service, can be regulated to hold within about one second a week; and its service life, if annually overhauled by a skilled watchmaker, is considerably in excess of 20 years.

GMT, for chronometer setting, can be computed from local time by methods outlined in your son's geography book; or determined from tabulations in the *Nautical Almanac* (p. 262-265, 1963 edition). Both local and GMT are regularly announced by your local Aeronautical Range Station.

Labels used on this equipment are Metalphoto, made and applied by the Kohler techniques[3]. Decals can also be used effectively, if they are applied carefully, and protected by a coat of clear lacquer.

With a time panel of this sort, the busy operator is never at a loss for the correct time, either local or GMT, and this time can be checked as often as desired against WWV or WWVH. With careful checking, station time errors in excess of 1/20th second should never occur. . . . IVES

[1]Valley, G. E. and Wallman, Henry, "Vacuum Tube Amplifiers," New York (McGraw-Hill), 1948, 401-403.
[2]Carter, D. F., "Parallel-T Nomograph," Electronics Vol. 30, No. 11, Nov. 1957, 192.
[3]Kohler, G. M. "Photography Produces Custom Labels," Electronics, Vol. 33, No. 1, Jan. 1, 1960, 100 et seq.

Oiler

Doctors are now using throw-away needles for penicillin on home calls. The thing consists of a glass tube with a needle at the end. All one has to do is to grind the sharp end flat, pull out the rubber plunger which is left at the bottom, and by attaching something to the plunger one has a very fine oiler. My doctor gave me a half dozen to experiment with when I mentioned that I thought I could use them. . . . . KϕHVK

These are not good playthings for the kids.

THIRD PARTY TRAFFIC

A reminder . . . Bolivia and the United States now have an agreement permitting the exchange of third party traffic by amateurs. Third party traffic may presently be handled with the following countries: Bolivia, Canada, Chile, Costa Rica, Cuba, Ecuador, Haiti, Honduras, Liberia, Mexico, Nicaragua, Panama, Paraguay, Peru and Venezuela.

A Remote Antenna Tuning Unit

Earl Murphy
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ANTENNAS IN GENERAL and mobile antennas in particular perform best at a single frequency and if operation over a band of frequencies is contemplated, as with a VFO, a means of tuning the antenna must be employed. This tuning can be accomplished at either the transmitter end of the transmission line or at the antenna terminals. In the first instance the transmitter output circuit or an antenna coupler at the transmitter can be adjusted so as to deliver most of the available power to the antenna. However at frequencies

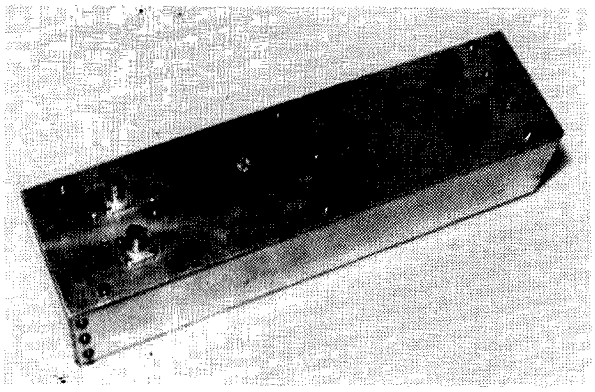


Fig. 1

where the antenna is no longer matched to the transmission line, usually away from the antenna resonant frequency, a standing wave will appear on the line. In many instances, particularly mobile installations where the antenna Q is high, the standing wave ratio can be quite large away from the resonant frequency of the antenna and in many cases these high standing waves cannot be tolerated. Also, the transmission line absorbs more and more of the power going to the antenna as the standing wave ratio is increased, lowering the overall efficiency. On the other hand, if the tuning is accomplished at the antenna terminals, the antenna will remain matched, or nearly so, to the transmission line over a band of frequencies. As a result of this the standing wave ratio will remain near unity over the frequency band thus maintaining good efficiency and avoiding the problems associated with a high standing wave ratio. What is needed then is a method of remotely tuning the antenna to keep it matched, or nearly so, to the transmission line. Many schemes have been tried with varying degrees of success and currently the most popular centers around either a tapped or continuously variable rotary inductor. This article offers a different solution to this problem in the form of a remote tuning unit that uses a variable capacitor for the tuning element. This technique, in general, is more economical in that the rotary variable inductors are expensive whereas a variable capacitor can usually be salvaged from the junk box. If the power is low, that is, less than about 15 watts, a receiving type capacitor can be used. It also appears that there is less contact loss in the capacitor than in the inductor. For what it is worth, it is also noted that the electrostatic field of the capacitor is much easier to shield than the electromagnetic field of the inductor. Also a more compact unit can be made using a variable capacitor. Fig. 1 shows a completed unit that measures only 12" x 3" x 2¾". The two binding posts are connections to the drive motor. All the components are mounted on the top panel as shown in Fig. 2. All of the parts were salvaged from the junk box except the aluminum box which

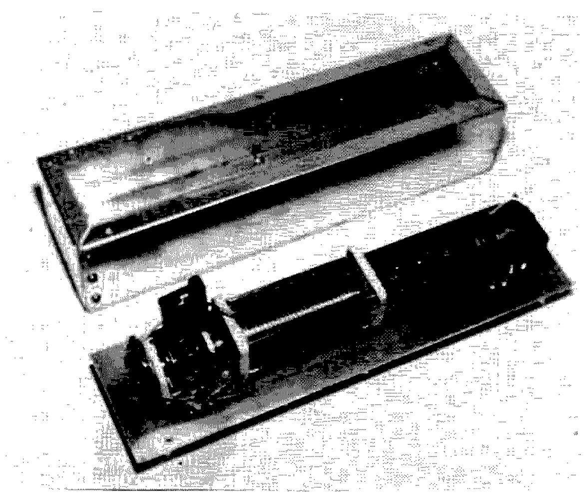
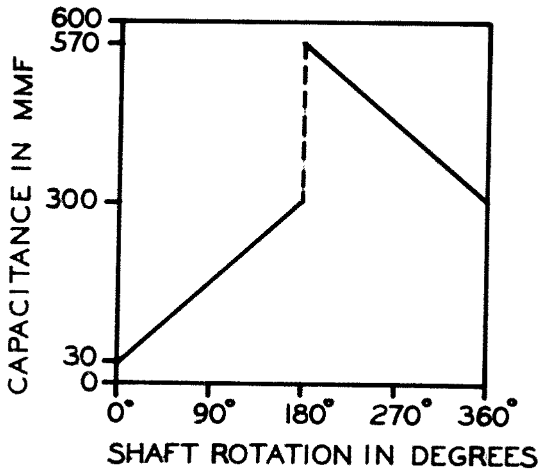
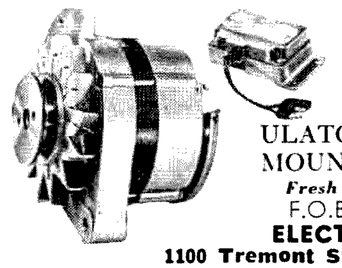


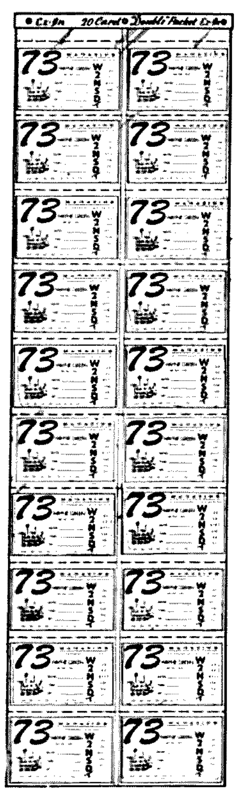
Fig. 2

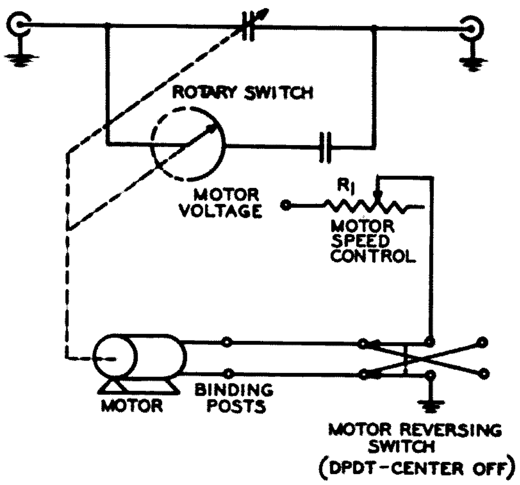
I made. The motor has a reduction gear drive and was designed for 28 volts dc. The 12 volt system in the automobile made it run at about 4 or 5 rpm which is a comfortable tuning speed. If desired, a speed control potentiometer (R_1 in Fig. 4) can be added to the motor control circuit. The size of R_1 for best results for a particular motor can readily be determined by experiment. It is necessary to obtain a similar motor regardless whether a capacitor or rotary inductor is used for the tuning element so the requirement for a motor is not a disadvantage for this unit. Similar motors with satisfactory performance can be purchased at many surplus stores. The rotary switch shown in Fig. 2 inserts a fixed capacitor in parallel with the variable capacitor for half the tuning range to double the capacity range. The switch is of the shorting type with half the contacts bussed together and adjusted so it inserts the fixed capacitor into the circuit as the variable capacitor is passing through maximum and removes it as the variable capacitor passes through its minimum. To assure maximum continuous coverage, the fixed capacitor should be as large as the maximum capacity of the variable capacitor minus the minimum value. That is, for a variable capacitor with a range of 30 to 300 mmfd, the fixed capacitor should 300 − 30 = 270 mmfd. A curve of capacity



versus rotation for this unit is shown in Fig. 3. As a further refinement, the switch could have been a double gang type and the second section could be used to light indicator lamps or drive a meter through different sizes of resistors to indicate the position of the drive shaft and hence, by experience, the antenna could be nearly tuned before applying transmitter power. A slightly more elaborate though more precise arrangement would involve coupling a continuously rotatable potentiometer to the drive shaft to drive a position indicating meter. Both sides of the capacitor are "hot" so it must be insulated from the box







and the motor and switch coupled to it by flexible insulated couplings. A circuit diagram is given in Fig. 4 where the dashed lines indicate mechanical coupling. A speed control potentiometer, R_1, and a motor reversing switch are shown at the remote control site.

In operation the tuning unit is inserted in the transmission line as near to the antenna terminals as possible. With the tuning unit in its maximum capacity position (just past 180° in Fig. 3) the antenna and capacitor combination is resonated at the low edge of the band of interest. The resonant frequency is then raised up through the band by decreasing the capacity of the tuning unit. By good antenna design and a judicious choice of tuning unit capacity the resistice component of antenna impedance can be made to stay near the characteristic impedance of the transmission line resulting in a low standing wave ratio across the band. While this unit was primarily designed for application in mobile installations, it can be used with any antenna that can be tuned by a single element at its terminals such as dipole, long wire, and vertical antennas. The unit pictured above was used successfully for two years in the author's 60 watt, 80 through 10 meter mobile station. Tuning was accomplished by operating the unit until the plate current meter indicated the antenna was loading. Crude but effective. Obviously for high power levels the antenna should be at least approximately tuned before applying transmitter power.

The almost endless combination of motors, capacitors, switches, potentiometers, and the like permit the unit to be built according to the designers partictular requirements, desires, finances and/or size of junk box, and is limited only by his imagination.

. . . W8HOA

Recipe for Cooked Ham

Ken Johnson W6NKE
21835 Rodax St.
Canoga Park, Calif.

TAKE ONE LARGE MEASURE of high voltage. Add to this various tubes, transformers and wire. Stir in some poor insulation and a bit of carelessness. Add a few unfused circuits, a couple of poor grounds and a spoonful of thoughtlessness. Throw in a ham and mix well.

It's quite possible that the ham may end up well cooked, although the time element varies with luck and the quality of the ingredients. This type of ham could be served up with all the trimmings, not in the gourmet atmosphere of a fine restaurant, but as the main course at the local morgue. Let's make it a point to avoid being on the menu at the latter establishment.

As a well known advertisement says, "don't be half safe." Take a good look around your ham shack and ask yourself, "how safe am I?" If you make a close check, chances are that you'll find some questionable wiring or a high resistance ground lead lurking in some corner.

Whether you run high power or low, the potential hazards are still there. Wherever electricity is found, so are the possibilities of fire and lethal shock.

Safety for the ham begins at the light socket, or power service outlet. Make sure that the size of wire used is sufficient to carry the required current and that the insulation is in good condition.

Design proper fuse protection into all of the primary circuits in your power supplies. Fuses are inexpensive and they may save you and your gear from disaster at some future date. Don't wrap lead foil around burned out fuses or use solder in the fuse clips as a temporary measure. Find out what blew the fuse and fix it before turning the power on again.

Select wire of the proper size and with adequate insulation when doing your circuit wiring. If you plan on harnessing your wiring into a cable, pay particular attention to the latter. The difference in potential between two adjacent wires may be very high and an insulation breakdown can cause no end of trouble, expense and danger.

Make sure you have good, low resistance grounds wherever they are required. The ground leads should be kept as short as possible to provide maximum effectiveness. Once

your transmitter or receiver is completed, use great care in giving it its operational checks. Keep your hands in front of the panel, away from high voltages while the power is on. If adjustments are necessary, make them with the power off. If this is impossible, keep one hand clear of the chassis and make the adjustments with the other. This may seem rather awkward but you will avoid making a complete circuit through your body if you should accidentally touch a hot spot.

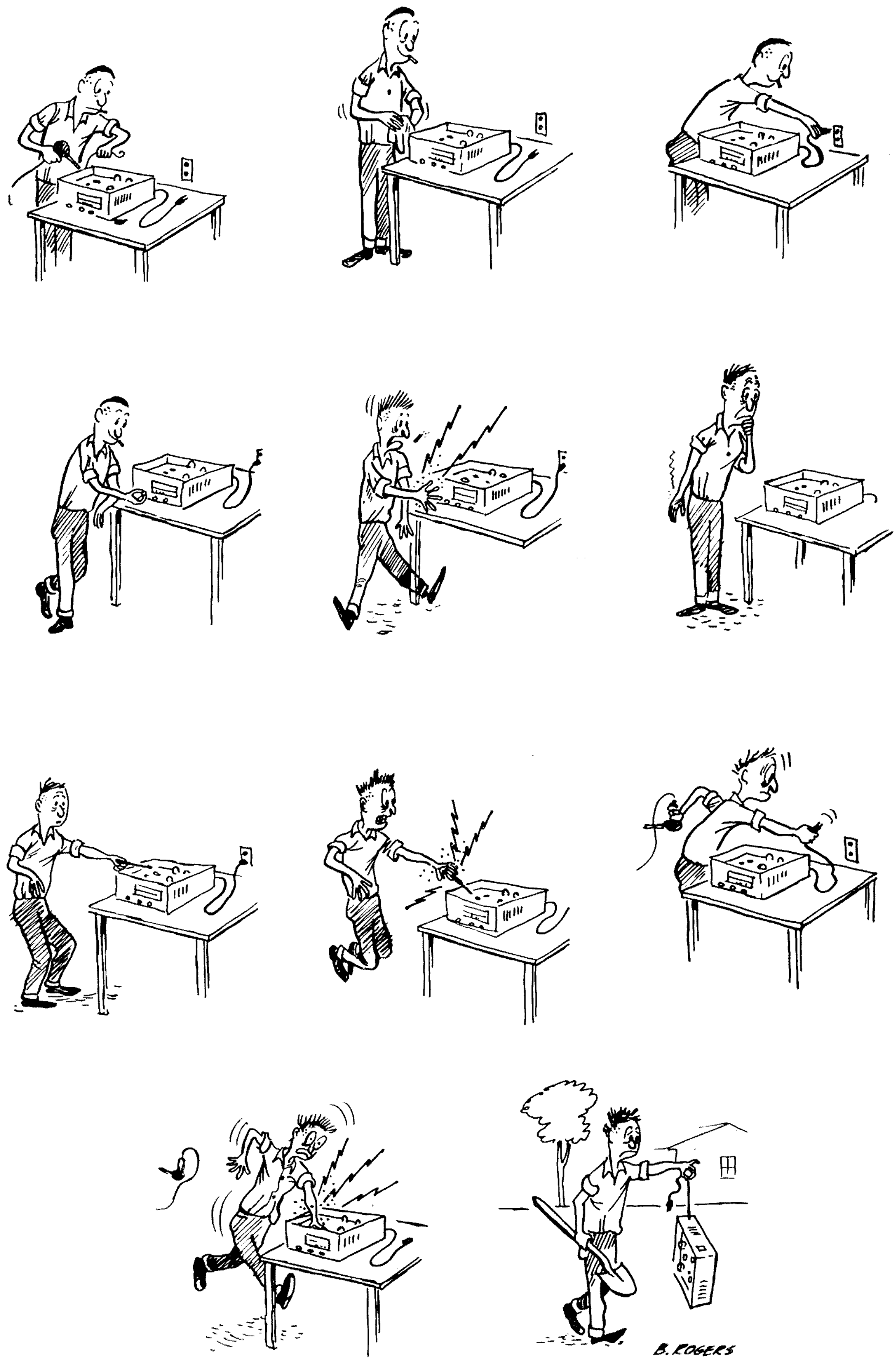
Serious shock, burns and possible death can result from coming into contact with the high voltages in any receiver or transmitter.

When assembling your station, be sure that you install a low resistance, common ground system for all pieces of your equipment. It may come as a shock to you, the hard way, to find that there is a difference of potential between your receiver and transmitter due to poor grounds. Each piece of gear should be connected to a good common ground with heavy braid or wire using lengths as short as possible to minimize the resistance. It is wise to check between chassis with a voltmeter to make sure that no difference of potential appears between them. Be sure every chassis is properly grounded.

Another point of possible hazard is the key in a CW station. This little rascal can be a lurking monster waiting to bite the hand of its operator during a careless moment. Depending on the keying circuit, the "hot side" of the key can be many volts above ground. Woe to the operator who, with one hand touching the receiver panel accidentally contacts the metal surface of the key with the other. It could bring his ham carrier to a screeching halt. Low voltage keying circuits and relays can solve this problem. At best, locate the key so that you can grab only the knob or paddles in an exciting moment.

Regardless of the physical location of your station, kids have a talent for getting into the most unexpected and carefully guarded places. If you are blessed with these little people in your home, devise some positive method of locking the power off in your station during your absence. Curious little fingers can twiddle knobs, throw switches and quite possibly bring disaster to themselves and their surroundings.

Regardless of who, where or what you are, there is no substitute for safety. Don't forget to incorporate and practice safety in your ham shack. If you must, go out and get "boiled" at your favorite tavern on a Saturday night, but don't take the chance of becoming a "cooked ham" in your ham shack. . . . W6NKE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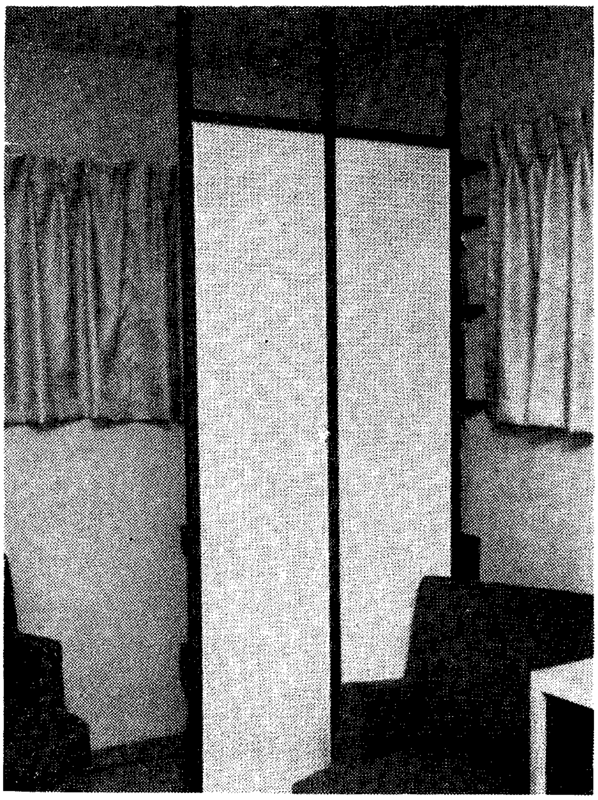
THE CURRENT PUBLISHING of many fine construction articles on electronic equipment and the appearance of a multitude of electronic kits on the market, by a host of manufacturers, covering just about every electronic component imaginable, would indicate that a large amount of home construction is being undertaken. On the other hand, the ever increasing presence of ready-made commercial amateur equipment on the air would indicate that a great number of hams are missing out on a very interesting and vital aspect of our hobby.

Among the reasons for this can be listed a very important one that usually escapes notice: the non-construction ham may simply not have a convenient place to work. At the very best, the usual workbench is an eyesore that is relegated to the basement or the garage, along with its owner. Even when a workshop is installed in such a location, the time spent at it can become a problem.

Fortunately, modern styling of amateur equipment has allowed the emergence of the amateur station from the attic or basement to the family room or den, placing ham radio operating on a more acceptable social level with other hobbies, such as collecting stamps or tropical fish. If the humble workbench could be given a similar face lifting, its stature could also be brought to a point where it too could be accepted into the habitable sections of the home.



Such an undertaking recently became a necessity for me since at this QTH there is no basement. In addition, the attic is unfinished, making the temperature unbearable except for a few days each spring and fall. As a result, for a period of time, construction projects had fallen to zero, and it was a rare instance when all the ham gear, hi-fi, TV's, etc., were all in working order due to the difficulty encountered because of the lack of a suitable place to work on them.

For the ham construction type of work to be undertaken, two places were actually needed:

1) A location with a good solid bench for metal and wood working—a place where the chips can fall as they may.
2) A well lighted, comfortable spot where assembly, wiring, and testing can be done.

The former may never achieve respectability. Fortunately, the heavier work occupies the smaller amount of time and the location can be remote. The old 200 pound monster made from 2 x 6's that had been used in previous QTH's was set up in the garage supporting a drill press, grinder and heavy vise. The car has to be backed out to use it, but that is not a real problem.

The latter activity is the part of home construction that consumes the majority of time and provides the most fun. Convenience would be achieved if it could be worked into the family room without ruining the appearance. Flushed with confidence from the success of not only installing the station in the spare bedroom used as a family room, but in having the XYL and Junior Ops pointing it out to their friends with pride ("Daddy talks to people all over the world on that"), I undertook to gain similar acceptance for a small workshop.

In considering possible solutions to the problem, the closet idea was judged impractical because there are no spare closets in this house. The folding-workbench-that-converts-into-a-beautiful-piece-of-furniture idea was

likewise discarded because of the woodworking skill required. The answer was to locate it in the far corner of the room and hide it with a disguise.

A lightweight 2'x3'x30" bench was made from ½" plywood and 1"x3"'s. This size was selected for several reasons. First of all it has casters and will pass through the doorways, making it very handy to wheel about when working on heavy components such as the final amplifier or TV. Secondly, the work surface is the height I prefer. Finally, the work area is the largest that was practical after the other considerations. A full size bottom shelf adds structural rigidity and serves as the location for the tool boxes.

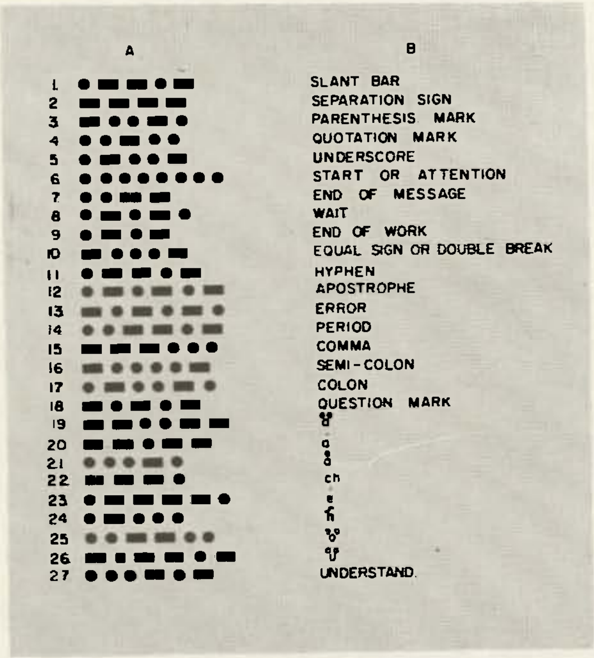
Four adjustable shelves, utilizing a clever bracket assembly obtained at the hardware store, were mounted on the wall above the bench to hold the smaller test equipments and parts. Electrical outlets were mounted on the workbench for convenience.

The disguise is a combination of a magician's illusion and a current decorator fad. The bench and shelves were painted flat black and located in the corner. A 3'x6' perforated decorator screen was placed at the side and the lighting in the room arranged so that the work area is not illuminated, except for work lights, of course, and the light that filters through the screen. When viewed from the sitting area of the room, the screen hides the workbench yet does not give the impression of reducing the size of the room. The black painted wood blends into the perforated pattern of the screen and cannot be seen.

The screen was constructed from a kit purchased from the local hardware store and cost about $15.00 for everything, including paint. The hardest part is the tongue and groove arrangement suggested by the manufacturer. Simple angle brackets were used instead, making the entire assembly much easier. After painting, the angles were not visible.

The scheme had worked perfectly. Not only is it very convenient and pleasurable to use, but the time available to use it has been more than any other previous arrangement, since it is in the room where leisure time is spent. The TV stays in operating condition and construction projects are completed without my disappearance into the basement.

A final word of advice; since it is rather radical to bring a workbench into the living area, it is essential to its acceptance that it never be called a workbench. Always refer to it as something more glamorous, such as the "Electronic Laboratory" or "Development Center."



Do you really know the code?

Carl Drumeller W5EHC

Every person holding a FCC-issued amateur radio operator license can, unless he is a liar, copy the International Morse Code at a speed of five words a minute or greater. Ah, yes? Do you think you know the code well enough to recognize the written symbols (dots and dashes) when you see them? Then try your hand at matching the dots-and-dashes in column A with the meanings given in column B. They're all from the International Morse Code!

For the answers, turn to page 87.

Coming Articles

General Coverage with S-line, K1DBR
Sixer & Twoer Modifications, K1GHO
Rotten CW Circa 1963, W1GQJ
Transistorized RTTY Converter, W1JJL
Putting Up a Quad, K2AAC
HE-45 Modifications, K2GOI
6DJ8 Converter for 6M, WA2HVK
Dual Mobile Antenna System, W2IAZ
Case for Balanced Pi-Net, W2LHB
Effective Filter Design, W2OZY
HE-35 Portabilized, W3IKH
Compact Full Size 20M Beam, W3PMV
Minute Motor, W3WPV
Last Word RTTY Converter, W3TUZ
Bandswitching Relays at VHF, K4GRY
Twin-City TU (RTTY) Mod., K4GRY
Tuned Feeders Forever, W4RGR
ARR-15 Conversion, W4WKM
RT-45/ARQ-1, W4WKM
ARC-5 Receivers, more, W4WKM
BC-230 Conversion, W5EHC
Bandspreading the BC-348, W5EUL
Product Detector with One Tube, K5JKX
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Power Xfmr to Fil. Xfmr conversion, W5VOH
12 Volts from 6, K6BIJ
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Push-pull 5763's on 144 mc, WA6SIZ
VHF Yagi's from TV Antenna, W6TKA
Two Meter DSB Adapter, W6TKA
Two Meter Coupler/SWR Bridge, W6TKA
Electronic Genius Confessions, K6UGT
Code Monitor for CW Man, WA6UVS
Panadaptor Converter ($10), K6VNT
Operating Table, WV6WAV
ARC-5 Modications, W7ATK
DX-60 Vector VFO, W7IDF
Bandswitch Swan 175 to 20M, W8DHZ
UB5UG's 5 Band Vertical, W8FAZ
Using the SWR Meter, W8JWP
Compact 40/80M Antenna, W8MPD
The Value of Two Meters, W8VVD
Preparing to be a Silent Key, K9AMD
Nu Nuvistor Approach, W9DUT
Vertical Antennas, W9EGQ
Mobile Field Strength Beefing, W9NTP
Noise Generator, K9ONT
98¢ Surplus Pre-Amp, W9SLM
VHF Tunable Oscillators, KΦCZD
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European Mobile DX, G3BID
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Cheap Phone Patch, K5HPT
Remote Antenna Tuning, WN2CQM
Radio Astronomy, WA2BWQ
Practical V Beam, K1MRK
SWR Meters, W2KPE
Amateur Radio in Britain, G3FPK
Further on the Windom, W3AFM
Diode Frequency Doubler, K6AI
Conquering Fading RTTY Signals, W5KEK
Rig Here is Homebrew, W5HJV
6/10 Meter Mobile Antenna, W3GSC
High Capacitance VFO, YU1FR
Constant Gain Audio System
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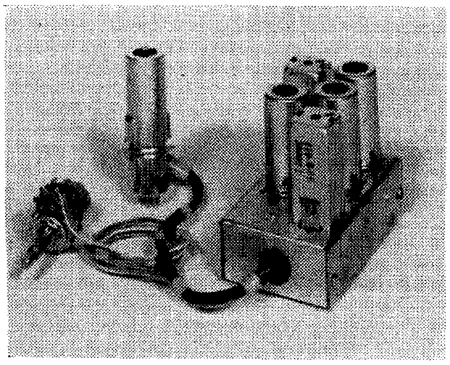
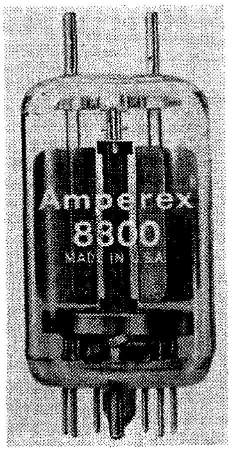
New Products



Noise Silencer

Owners of Hammarlund HQ-170 and 180 receivers should get in touch with Hammarlund immediately about adding a heavy ignition or pulse type noise silencer which has been announced. This accessory sells for $33.50, uses three tubes, and works on all modes of reception. Hammarlund, 460 West 34th Street, N.Y. 1.



SSB Power Tube

Home constructors and engineers may well be interested in the new Amperex 8300, a twin tetrode with instant heating filament for mobile SSB rigs in the 200 watt input range. 73 would look favorably on an article on a rig using one. Write Amperex, 230 Duffy, Hicksville, L.I., N.Y. for specs. Mention 73.

New-Tronics

has one of the most complete lines of mobile antennas and accessories we've seen. You'll certainly want their new catalog 68NC. Write New-Tronics, 3455 Vega Avenue, Cleveland 13, Ohio.

Waters Coupler

Owners of a Waters Universal Hybrid Coupler that haven't sent in their warrantee postcards (about 80% of the owners, unfortunately) will have to write for the modification sheet on this unit which tells how to get even better operation with tape recorders. If you have one of these couplers you'd do well to get on their list. If you don't have one then rush out and buy one and get on the list. Don't miss this list. Waters Manufacturing, Wayland, Massachusetts.

Six & Two Meter Converters

Lafayette now has a six meter converter (Model HE-56, $29.95) and a two meter converter (HE-71, $31.95) available. The outputs are 7-11 mc for both and they have built in power supplies so you don't have to sap your receiver. Questions? Write Lafayette, 111 Jericho Tpk., Syosset, L.I., N.Y.

RTTY Award

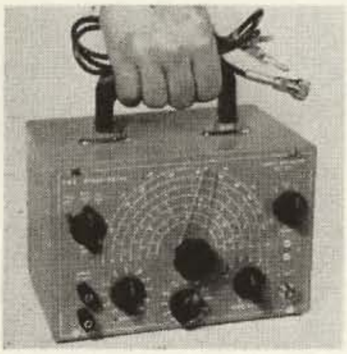
The RTTY Bulletin, Box 6047, Daytona Beach, Florida has a nice certificate available for RTTYers who can produce QSLs showing two way RTTY contacts with all 50 states. Send cards, get back cards plus certificates.

Catalog

The 1963 model International Crystal catalog is now out and you'll be sorry if you don't have one. They have quite a collection of small circuits and power supplies available in addition to crystals for any application you can imagine. 18 North Lee, Oklahoma City, Oklahoma.

40 & 75 Meter Dipoles

New-Tronics Corporation has announced their new rotatable remotely tuned dipoles which are available for 40 and 75 meters or a combination of both frequencies. They tune across the entire band from inside the shack, are fed with 52 ohm coax and use no traps, baluns or matching devices. Will handle a full kw. The largest model is only 31 feet long. Maybe you'd better write for full specifications on this one, eh? It can probably do a lot for your signal on the lower frequencies, particularly if you are a bit short of antenna space.



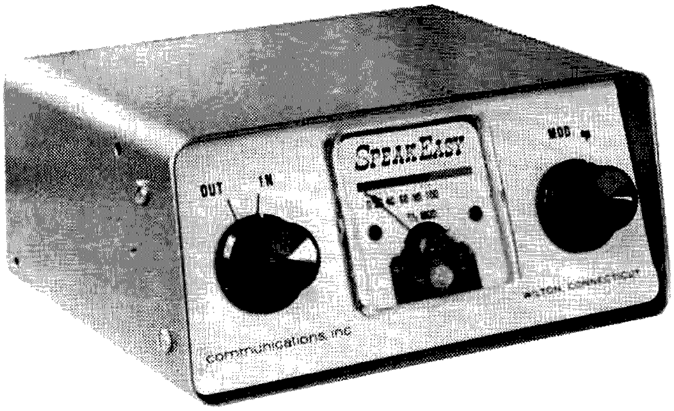
Transistorized Signal Generator

Quite a package. 135 kc to 120 mc on fundamental and up to 240 mc on harmonics; battery powered; 3 lbs.; internal or external modulation; crystal test oscillator; $34.90 in kit form. Write Pel Electronics, 214 Main Street, Hackensack, N.J.

Globe and Subscription: $16.95

If you shop around carefully in other ham magazines you may be able to find this very same globe with no subscription bonus being sold for a paltry $19.95. When you think it over carefully I am sure that you will see their point and order a globe from them for it certainly is worth that three dollars extra not to have another year of 73 to worry about.

In case I have not been as persuasive as usual and you still insist on ordering this terrific 18" diameter (nearly five feet around the equator) world globe and the one year subscription or renewal that goes with it whether you like it or not (unless you are a life subscriber in which case drop us a line for your special deal which I daren't publish for fear of starting a rush for life subscriptions). These plastic balloons are guaranteed, so don't grumble about what happens when it gets old. I have two of them that have been kicking around for over seven years now and they are still going strong. Use them all the time. Deflate 'em when going to hamfests or moving. Just jot your name, address, call, new or renewal sub (give expiration date if you know it), and bundle this up with cash, check or money order (U. S. or Canadian) and send it to us: 73, Peterborough, N. H.



Speech Clipping

THE ARTICLES IN amateur magazines extolling the advantages of speech clipping have apparently not all been in vain for we find that some commercial units are now appearing to accomplish this function. In addition to the C-Y Electronics "Chatterbox" which we reviewed in the December issue of 73 (page 19), there is the Speak-Easy, being manufactured by Instruments and Communications, Inc., down in Wilton, Connecticut.

Rather than have you flounder back through your magazine library or pull a strain lifting down the new Editors & Engineers Handbook to find out about speech clipping, we'll indulge in a short non-technical discussion.

First let me explain, no doubt to the horror of the manufacturers who are intensely emotionally involved with this, that a signal with the speech well clipped sounds lousy. It sounds loud, distorted, and unnatural. It is.

Under normal conditions, if you ever happen to run across normal conditions, it is very annoying to sit and listen to all the racket put out by a speech clipped rig. The difference comes when you are trying to eke a weak signal through the noise, at which time the clipping makes a world of difference and you bless every db of clipping and the redundancy of our English language. That noise, incidentally, can be from Papa Thor, ten W9's on the same frequency, the razor next door, or from your first rf stage. Clipping helps.

Someone always wants to know how things work, so I suppose we should at least give a hint, or maybe pile confusion upon confusion. It's like this. Our voice is made up of a bunch of sine waves of many frequencies. Some of these are high (loud) and many are wee. The result of this is that when we set the gain control of the transmitter so that the peaks of the voice reach 100% modulation, the average modulation is quite low. If we put the voice sine waves through a clipper, we shave off the tops of the higher sine waves until we are down to the lower ones, making our speech into more like a series of square waves, all reaching to the 100% level. Our average percentage of modulation can thus be increased tremendously. You can go too far with this, of course, and end up with something that is hard to recognize. Oh, you have to put a little filter in there to smooth the sharp corners of those square waves elsewise you will have a very broad spattering signal, for these little square edges are actually high audio frequency harmonics which make your signal occupy more than the regulation 3 kc sideband.

If your ham operating is of the rag-chew-with-local-station variety then you will have little need for a clipper. CW-only operators may also feel that this is of little moment for them. But if you occasionally attempt to get in over your head and wrest a QSL from one of the choicer DX stations, or try to work out a little on the VHF's, or attempt anything at all on 20 meter phone, then you might well consider building in a bit of clipping or buying one of the commercial units.

The C-Y Chatterbox ($24.95) connects between your mike and the speech amplifier and is transistorized and self-powered. The I & C Speak-Easy is a small console job, complete with modulation percentage meter, which connects into your transmitter or transceiver. We found the connections to the Clegg 99'er to take only a few minutes and that the Speak-easy not only was a help with its clipped and filtered audio when things got tough during band openings, but that the modulation meter on the front panel was edifying and assuring to watch as we talked. It eliminates any guessing about how well you are filling out the carrier and you can back off from the mike as much as you want, correcting for the distance with the gain control and know how you are doing without having to ask.

The Speakeasy comes in kit form for $24.95 and gives you quite a lot for that price. The kit goes together easily, being mostly a printed circuit board. You can spend $34.75 and get the unit ready to connect to your rig. The Speakeasy is available at most radio parts distributors or from Instruments & Communications, Inc., 33 Danbury Road, Wilton, Connecticut.

. . . WAYNE

Letter

Dear Wayne,

I have always been particularly impressed by your magazine's articles on the modification of ham gear, but your January cover has out done them all! Imagine! A modification of the U, S & A!

A moment's thought on this momentous undertaking leaves me with a few doubts. How are your Brooklyn offices managing now that Long Island has apparently sunk into the sea? And don't you think the self-styled anti-communists of California will be enraged to find that the Florida Keys have been ceded to Cuba? Personally, I am delighted to find myself living in a new state made up of what was formerly Illinois, Wisconsin, and Michigan's upper peninsula. But I wonder how the boys on the upper peninsula will now sign their calls. W8XYZ/9? W8/9XYZ? W9/8XYZ? Well I'm sure something can be worked out.

I'm certain North Dakota will be happy with its acquisition of half of South Dakota. South Dakotans need not worry, for their state has absorbed all of what used to be Nebraska. Not to be out done in this coup d'etat, Nebraska has retained its original shape and devoured Kansas, which no longer exists, except for the members of a provisional government who are being sheltered, I understand, by some subversive Oklahomans. Our friends in Nebraska have really done it up well. They've put a big chunk of Colorado out of business too.

Perhaps in the near future you'll run an article explaining how this conversion was accomplished. Oh well, it probably starts out "First remove all wiring and components except the fuse holder in the upper left. . . ."

Seriously, Wayne, I enjoyed the January issue as thoroughly as I did all the others. 73 continues to be my favorite of the big three.

In reply to your editorial inquiry, the best way to get me to subscribe instead of buying from the newsstands would be to make sure that new subscribers start getting their copies within a reasonable time. I have a few friends who sent their money in October, have received cancelled checks, and have just bought the January issue at the newsstand.

Usually I find my head bobbing up and down as I read your column each month, but this time I found it swaying from side to side as you suggested that it was my duty to keep the ham magazines in business. I've always thought that it was a businessman's duty to keep his product worthy of continued consumption. QST is an

SSB Dinner March 26th

The Twelfth annual SSB Dinner will be held at the Statler-Hilton in New York with displays opening at 10 AM (73 will probably be there) and dinner at 7:30 PM. Steak dinner is $12.50 if you pay in advance: SSBARA, Buddy Robins W2JKN, 4665 Iselin Ave., New York 71, N. Y.

Mobile Rally in Belgium

Word from the Amateur Radio Mobile Society (G3BID, 5 Ferncroft Avenue, London NW3) tells of an international mobile rally to be held April 28th (Sunday) in Verviers (Eastern Belgium). If you are going to be driving around Europe at this time make it a point to be there.

excellent example of this. I haven't bought one copy of that rag since they began insulting my intelligence by begging for contributions to their ridiculous building fund. What is the ARRL becoming anyway, a church? At any rate Wayne, keep up the good work and I'll keep on buying. And if it appears that I can expect prompt delivery on a subscription one of these days, I'll send you a check.

If you've managed to get this far, thanks for listening. One day soon I'll re-do a map of the Soviet Union, and perhaps you can use that on your cover.

Dale Ulmer, WA9CZQ

All 73 readers except Dale get two demerits for missing the map that I hid on the cover last month. Heh, heh! And I even gave you a broad hint on page one too. Tsk. Now, about those subscriptions; whooey . . . what a problem. Just a little over a year ago the cutting and filing of subscription stencils began to be too much for us to handle by ourselves without quite an investment in larger machinery. I spent weeks trying to solve the problem. Finally I farmed the job out to a commercial firm that specialized in this and everything ran fairly smoothly until last September. Our first issue was in October 1960, so everyone who had a subscription from that first issue came up for renewal in one big lump. During September and October we had well over 10,000 renewals in addition to the usual number of new subscriptions. This did it. I began to suspect that all was not well by late November when the complaints started coming in. By mid-December I was ready to commit mayhem if an ulcer didn't finish me off first. I called and called, getting the same message each time, "We'll have everything caught up in a few days, don't worry. Send us the complaints and we'll check them for you and print the stencil on it to prove everything is OK." By Christmas (Merry Christmas!) the complaints were outnumbering the subscriptions and some of the more sour dispositioned of our readers were accusing us of fraud, Better Business Bureau, post office violations, and so forth. We may be TARFU, but we're not crooked, so the few who got definitely unpleasant received refunds of their subscriptions and a note saying that no further subs would be accepted from them, ever. The only solution to this whole miserable problem was to buy the machinery, hire the help, and move the stencil department up here with everything else. The machine cost well over $1000, counting the needed accessories. Special typewriters ran up the bill even more, plus the time and phone calls to locate all this. We've hired two new girls to handle the stencils and subscriptions. And we had to cut down to 80 pages with the January issue to help get us through the unexpected financial drain. We'll have everything moved up to New Hampshire by the time you read this and I think we'll be able to keep things running smoothly this way. My apologies to everyone who suffered with us through this growing pain. Now, the last item Dale, and I came close to editing this out of your letter, being held back by some vestigial shreds of journalistic honesty which whispered to me that, right or wrong, you have a right to say your piece. Is it really fair to pass moral judgment on the League as you have done without knowing all the facts? After all, the decision to finance the new headquarters building (did you see the picture of it in the January QST on page 62? It is immense!) by donations from League Members was made by the Board of Directors. I am sure that the Directors of the League must have had adequate and good reasons for this move and that, if we knew them, we would understand and approve. . . . wayne.

(W2NSD from page 6)

quered by the U. S. at any time in history . . . etc. Permission is hereby specifically denied for any of these awards to be listed in the Directory of Certificates and Awards or in CQ Magazine. These are our awards and *only* 73 readers should know about them.

IoAR

The deadline is drawing near for anyone who is considering going along on our tour of Europe next fall to join the Institute. The rules for a charter flight specify that everyone must have belonged to the chartering organization for at least six months before the flight. When you consider that the normal fare for a round trip economy (the cheapest fare) to Rome is $630, you can see that our group fare of $500 round trip, including London, Paris, Geneva, Rome and Berlin plus accommodations and breakfasts in these cities qualifies as quite a bargain.

If enough west coasters are interested we can arrange for a second group to leave from Los Angeles, but this will up the cost a bit, naturally. Even so this is probably one of the most economical ways to make the trip and it will be with a group of fellow hams, which will make it a lot more fun than such a trip would be if you were all alone.

We are making arrangements for hospitality during our visits to the five cities. Between the RSGB, the REF, the International Ham Hop Club, The DARC and other clubs we may be able to meet local hams and get a nice personal welcome to each city. Those of you who are planning on making the trip might start looking for DX hams near or in these cities and finding out what points of interest they recommend.

In order to keep the total cost of the trip down to ham level, I wil make reservations at second class hotels. Those of you who have traveled to Europe or who have read "Europe on $5 a Day" (excellent book), will know that this is the best bargain in such travel for the hotels are spotless and are different from the first run expensive hotels in that they are usually smaller, located around the corner on a smaller street, and are more friendly. These are the hotels that the Europeans use and they are a lot different from the expensive American type hotels. The trip will be one you will never forget and one you will want to make over and over, once you have tasted the delights of Europe.

The enthusiasm for our European trip has brought in several suggestions for further trips and we have tentatively started planning for a 1964 spring trip through Mexico, Central America, across northern South America, up the Leeward and Windward Islands and back. In the fall of 1964 we figure on running a flight to Oslo, Stockholm, Copenhagen, Helsinki and Berlin. If you have any other suggestions let us know and we'll see what reaction we get from the IoAR members. Obviously I cannot be a tour director on so many trips, so

were open for any volunteers that have the know how to set up the plans and who would like to work on this. This might be something ideal for one of our retired hams to get his teeth into. We'd like to have all trips be made for the lowest possible cost per person, with just a small profit left for the Institute to help it grow and be able to thus finance further trips.

Charter members of the Institute (those who joined before Dec. 31, 1962) will have first choice of seats on all flights. On many planes charter groups have a number of first class accommodations available and it is a lot more comfortable to fly in these. Charter members will also, in effect, get their membership donation of one dollar back if they mention Charter membership to the IoAR on their next subscription renewal to 73 and send us one dollar less than the regular subscription fee for the magazine.

Vitriol

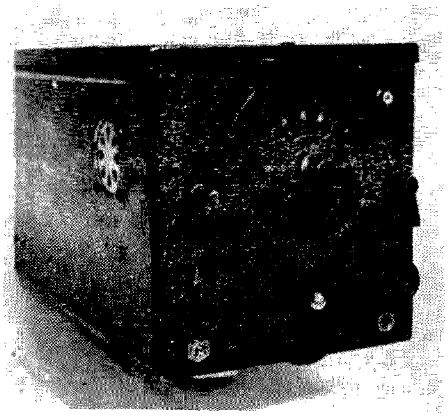
It is annoying to see the ARRL being so viciously attacked by CQ's OLD MAN, particularly when he is so completely off base in his criticism. While most of the ham publications, club bulletins and such are doing yeoman work in building up our hobby, it is painful to see a couple of mimeographing Californians swinging an axe at our underpinnings with such bitter determination. Those of you who are on the mailing list for this trash would do everyone a favor if you would protest this destructiveness and/or ask that you be removed from the mailing list.

CB or Not CB

The FCC has proposed some new regulations for the CB'ers. These rules are obviously aimed at eliminating the ham type of operation from the Citizen's Band and, if they are adopted, there may be several thousand displaced CB'ers working for their Tech tickets. I suspect that along this Spring some time there may be a great demand for articles on converting CB gear for six meters. This may have a temporarily depressing effect on the CB manufacturers, but perhaps we will find them following their market to the ham bands.

On the other hand it is entirely possible that carelessness of the FCC, in their original writing of the regulations and their subsequent lack of clarification or enforcement may come back to haunt them. Tens of thousands of fellows have invested in CB equipment to pursue the hobby of CB chit-chat and they may be a force to be reckoned with.

. . . WAYNE



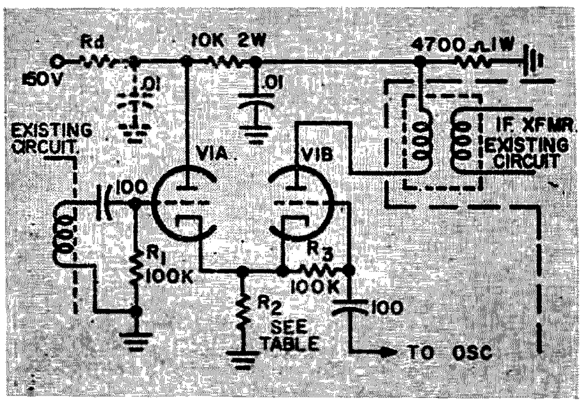
Like New RAX

Edwin Cole W7IDF
P. O. Box 3,
Vashon, Wash.

JUST WHEN I THINK OUR World War II surplus has been thinned out somebody comes up with a new idea that makes working the old diggings profitable again. Green's Impartial Statistics Agency regularly proves with sly pride that 73 is the best source of such fresh thinking on the technical front. And sure enough, look at page 32 of the October 1961 issue, and the letter from K6BHN on page 39, May, 1962.

The "Like New Mixer" plus one RAX-1 (more about this later) can provide a receiver with superior signal-to-noise ratio and more than adequate stability for sideband service. For a very few bucks you can supply drift-meter readings to your friends on the round table. They like to know when they slide around and will compliment you on your accuracy, honesty and gall.

My first thought was to turn the mixer circuit into a converter type front end as simply as possible. My second thought was to buy an RAX-1 for the tuneable intermediate frequency section. Two thoughts per project is my normal workload. A nine turn length of 3011 Miniductor with a three turn link and a broadcast variable were added where "existing circuit" is indicated in the "Like New" circuit. This junk-box expedient tunes forty and twenty. The coil is ¾ inch diameter, sixteen turns per inch. A 12AT7 was used for the mixer, and half of another one for a Pierce oscillator to take care of the beat generation. Despite the socio-economic pun this combination works well enough that ideas of an rf stage and a more sophisticated oscillator were abandoned. I suspected that with the feeble input voltage from the antenna the signal-to-noise potential of the mixer circuit would not be fully exploited. This was confirmed by an annoying comparison with a more elaborate unit built by W7ATK; nevertheless simplicity is a vanishing virtue I cherish, and with the added leverage of a well-fed doublet cut to 7050 the performance on forty is good.



The 73 mixer circuit using a 12AT7 plus half of another 12AT7 as a Pierce oscillator. A 7 mc doublet and the coil-condenser combination in the upper left corner replace the normal IF transformer input. The four crystals permit tuning forty meters on any of the RAX-1 band positions, and certain commercial stations (crystal on the high side by tuning backwards—which is good enough for them.

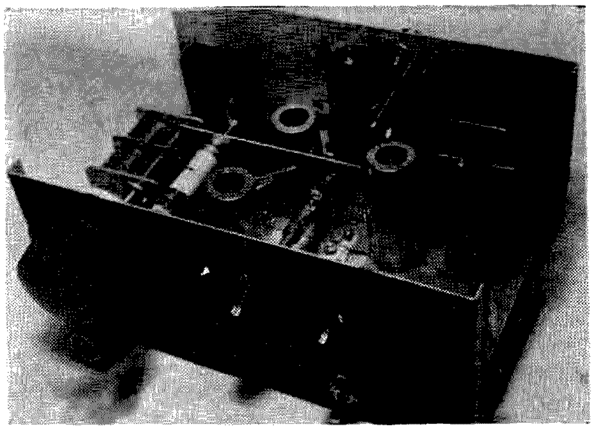
The simplest application of the 73 mixer and the RAX-1 is worth trying if you want a receiver of moderate sensitivity and exceptional stability and calibration utility (this last means the dial is readable to a fine point and stays put). As it happened I thought the sensitivity was very good until I heard what resulted when W7ATK's rf stage boosted the signal and gave the mixer something to work with. But even without the rf stage the performance left me with this conclusion: I could buy a better receiver but I wouldn't dare bring it home. What began as a tentative experiment jelled as the station receiver and no elaboration is contemplated until solar storms or bigger test shots bring ten meters back. That

occasion will be celebrated with an rf stage and an overtone oscillator. The harmonic of crystals used for forty meter reception works fine on twenty but to go any higher with a receiving crystal in the 6 mc range means a ubiquity of beats. That last phrase belongs in the mode configuration, dial excursion type of magazine, but you know what I mean. Harmonic mischief.

The RAX series has been around for twenty years or so, but it was new to me and maybe it is to you. The RAX-1 circuit and tube lineup are much like the BC-453, but it is twice the size, strictly front panel local control, covers 200 kc to 1500 kc in four bands and has a lovely big dial. The intermediate frequency is 160 kc. It's a beautifully built receiver and very easy to work on. My first one I used without much modification until W7ATK talked me out of it, to my lasting regret. A second was on order and when it arrived I sawed off the dynamotor apron, removed two low frequency series traps (the cans marked Z-101 and Z-102), paralleled the filaments and found room inside for a transformer power supply and a speaker. A VR tube was added too, and taken out again when a check of the designed-in stability proved regulation was superfluous.

Two admonitions are relevant here. I bought my RAX's from Columbia Electronics and I'm a satisfied customer, but I achieved this status the hard way. When the first RAX arrived I opened the sturdy carton, removed quantities of padding and gently lifted out a receiver tightly wrapped in heavy brown paper. Gee, new or reconditioned? The evidence of extra care in packing didn't prepare me for the outcome. Tearing away the paper released a small flood of fine, brown sand, and the implication in this was soon confirmed. The tuning knob couldn't be budged. Efforts to turn the band switch resulted in a horrid grating and more sand. Much of the paint was worn from the front panel and the pressures of wartime communication had left several dents in the thin aluminum dial cover. Depressing. But as I said before these receivers are easy to work on and it wasn't really much of a job to get the front end cleaned up and the gears greased. The wiring is unusually accessible under the roomy chassis and tracing is simple. As it turned out all three receivers (and presumably the fourth, due soon) worked fine as soon as power was applied, and I accept the near cupful of sand in each one as the price of dry storage over the years. Real dry.

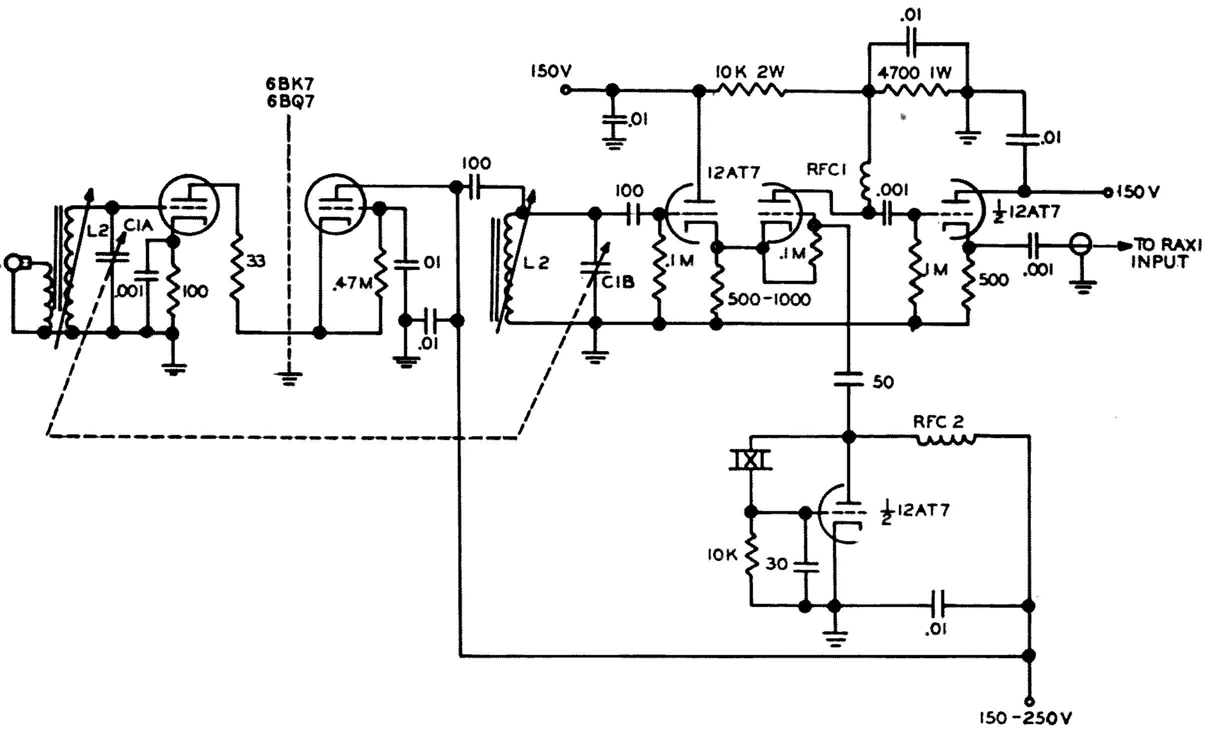
With my second order to Columbia I had enclosed a note reporting the condition of the first shipment and offered to pay a reasonable



W7ATK's heavy duty model. Rear left rf stage; front left mixer with tapped slug-tuned coil covering 80, 40 and 20; front right 12AT7 oscillator—if cathode follower. Photographed under conditions of constant bragging.

premium for an RAX in better shape. They replied that my description probably could apply to the balance of these receivers on hand, and that I should expect additional units to be in comparable condition. I did, and they were. So if you get sand in your shoes think nothing of it. Just dismantle, clean and lubricate. It's a lot better than rust and corrosion, and in the past year my receivers have been used a lot with no component failures. Fifteen dollars isn't much to pay for a reliable broadcast and beacon band receiver with excellent stability, good selectivity and low noise contribution.

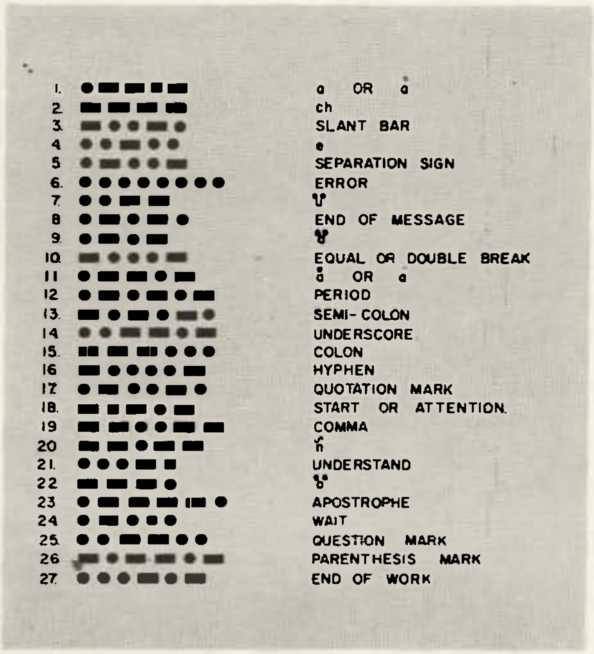
The other qualifying note, referred to earlier, is in reference to the expedient of simply hooking an antenna and coil to the "Like Newer." As you would guess, skipping pre-selection can pay off in images. I attacked this situation slantwise by using three surplus crystals for forty meter reception. Normally I use 6000 kc and tune forty from 1000 kc to 1300 kc on the RAX-1. This gives the advantages of direct calibration and best image ratio for the circuit. If a troublesome image does pop up I switch to 6500 kc and tune from 500 kc to 800 kc. With a 6800 kc crystal and tuning from 300 kc cranking in the sidebanders on the high end is good fun. You don't need a steady hand. In fact the receiver seems broad until you count the kilocycles on the dial. The fact that the best image rejection is on the top band and the best bandspread on the lowest band you can call flexibility or natural contrariness. Of course if you do the job right and use W7ATK's circuit you can forget about images. The coil and condenser combination he gives covers eighty and forty, and a 3000 kc crystal can be used for both bands. The circuit for the RAX-1 is in Kenneth Grayson's "Surplus Schematics Handbook." . . . W7IDF



Value of R2	100	500	1000
Input—Voltage (Signal)	1.4	7.0	14.0
Input—Voltage (Osc.)	1.6	7.0	13.1
Conversion—Gain if IF Xfmr Impedance Is 50K ohms (For Comparison)	100	150	160

Answers to Code Quiz

(from page 76)



A Precision Frequency Standard

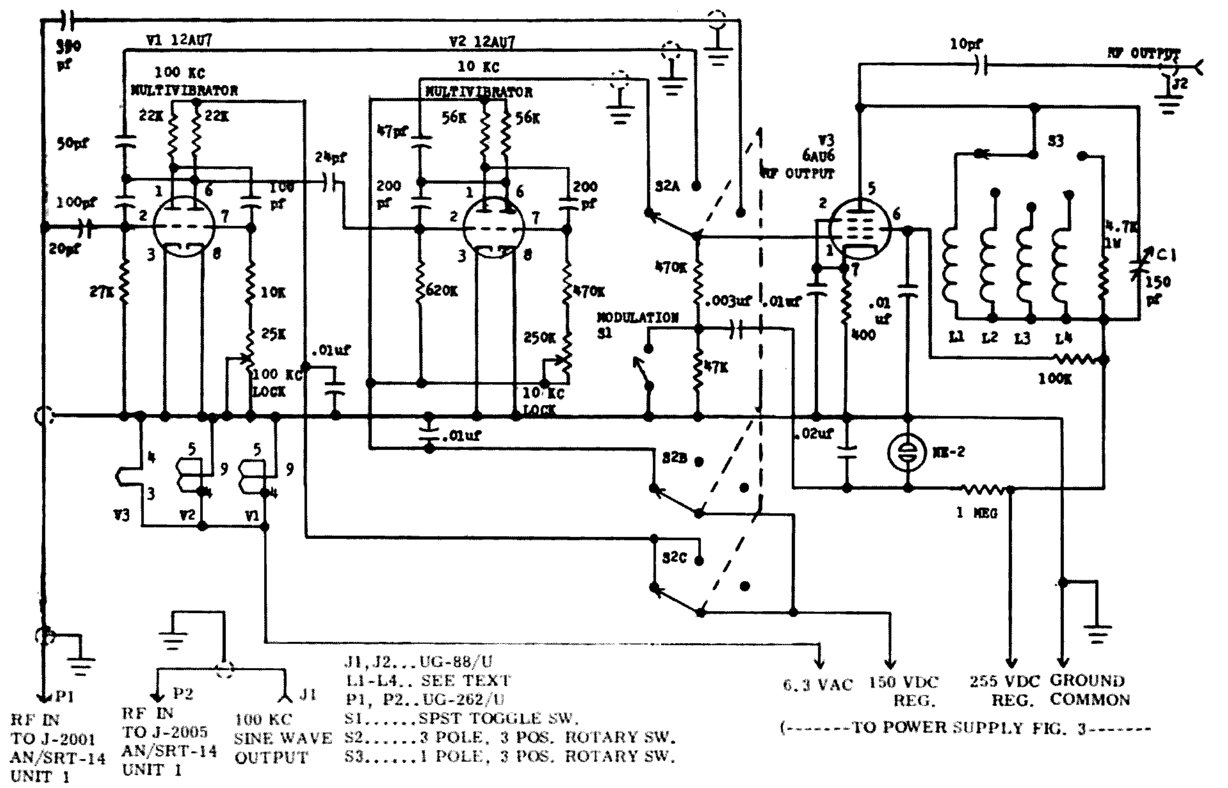
Using the AN/SRT-14

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia
Photography by Morgan S. Gassman, Jr.

THE SUBJECT OF PRECISE frequency control and measurement is becoming of increasing interest to a growing number of amateur operators. The general use of receivers with calibration accuracy approaching that of some frequency meters has pointed up the unmistakable operating advantages that are obtained with precise frequency calibration. This is aside from the personal satisfaction of knowing precisely where you are in the band.

Many amateurs with older or less expensive modern receivers have updated them by installing 100 kc crystal calibrators. While this is all for the good, it is a long way between those 100 kc check points and the existing dial calibration is rarely good enough for accurate interpolation. With most receivers, more closely spaced, readily identifiable check points are desirable. A further point, worthy of consideration, is that many of the available 100 kc calibrators leave something to be desired in stability. While a drift of 10 cps seems inconsequential, it becomes significant when we are using the 300th harmonic to check a 30 mc signal. This 10 cps drift then becomes a 3 kc measurement error.

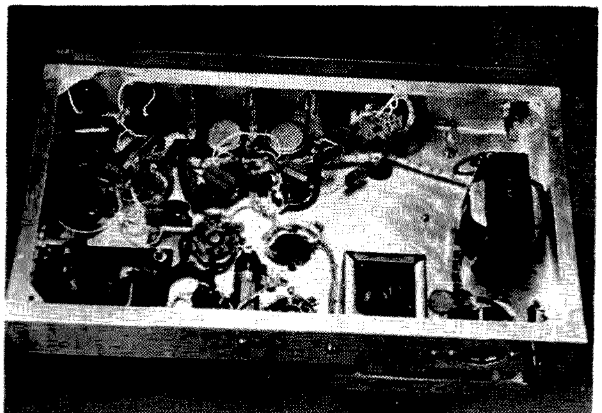
Two things are then required to insure accurate higher frequency calibration and frequency measurement. The stability of the standard should be as great as possible and identifiable calibration frequencies should be generated at closer spacing than the usual 100



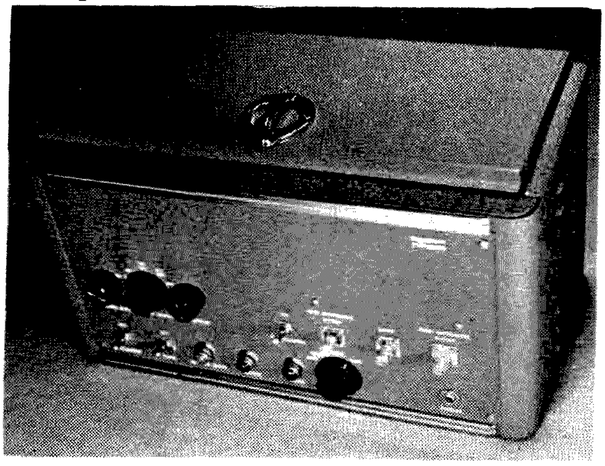
kc. Both objectives are achieved in the unit shown in the photographs.

The heart of this frequency standard is a surplus, high stability 100 kc oscillator unit. This oscillator is Unit 1, Z-2001, of the AN/SRT-14 Radio Transmitter. Other components of this surplus dream were described in the article, "A Surplus Frequency Synthesizer," which appeared in the February, 1962 issue of 73 Magazine. The oscillator unit is a real gem. The crystal proper is a Bliley Type BH8, 100 kc unit which is housed in a 3⅜" diameter, 4½" high plug-in oven. The oven is a Bliley Type TC922 which operates from 6.3 volts ac and maintains a constant 70° temperature.

The circuit of the oscillator unit is shown in Fig. 2. A 5654 (6AK5) oscillator stage drives an isolation cathode follower stage which, in turn, drives 3 separate cathode follower output stages. All cathode followers use a single triode section of the dual-triode 5814 (12AU7). Isolation resistors are used to provide five independent, low impedance outputs which are terminated in BNC coaxial fittings mounted on the top of the chassis. The Unit 1, AN/SRT-14



Under-chassis view shows further construction details. The detector-audio amplifier circuit shown on the left side of the chassis is not described in this article.



The frequency standard is housed in a stock Par-Metal cabinet.

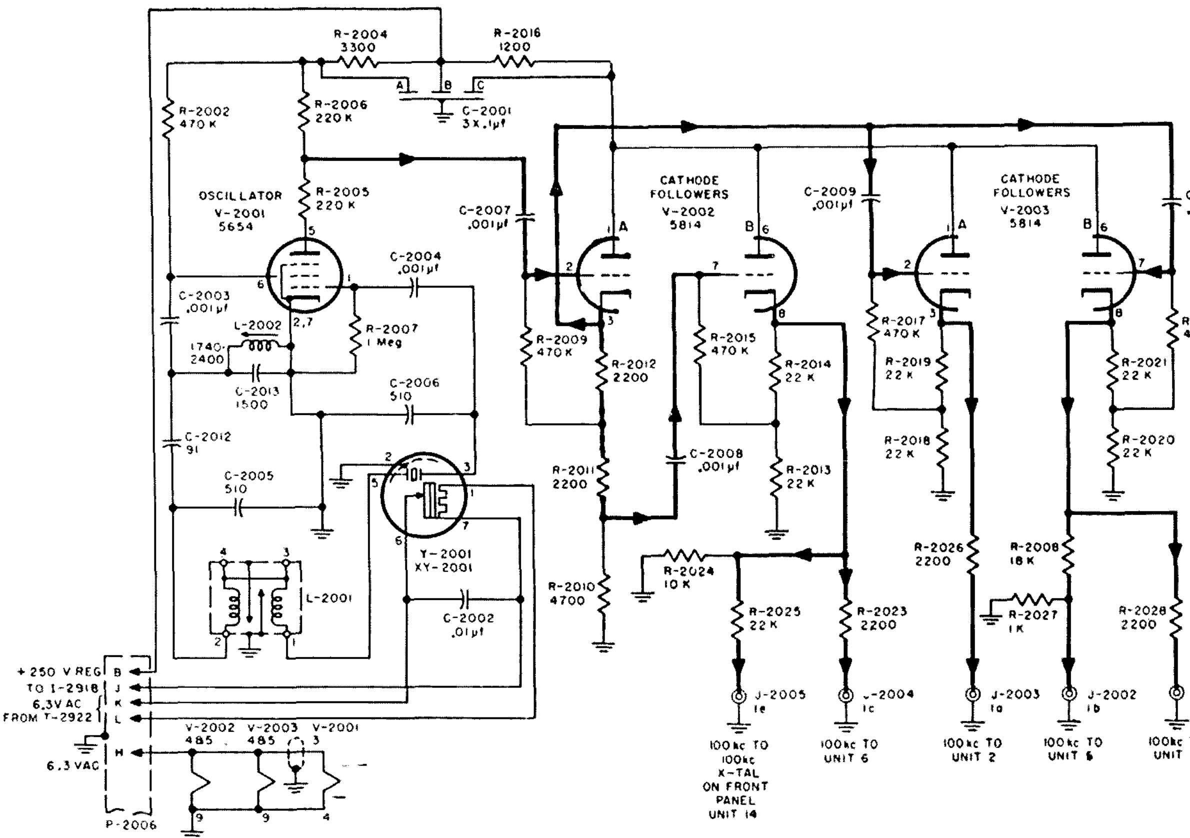
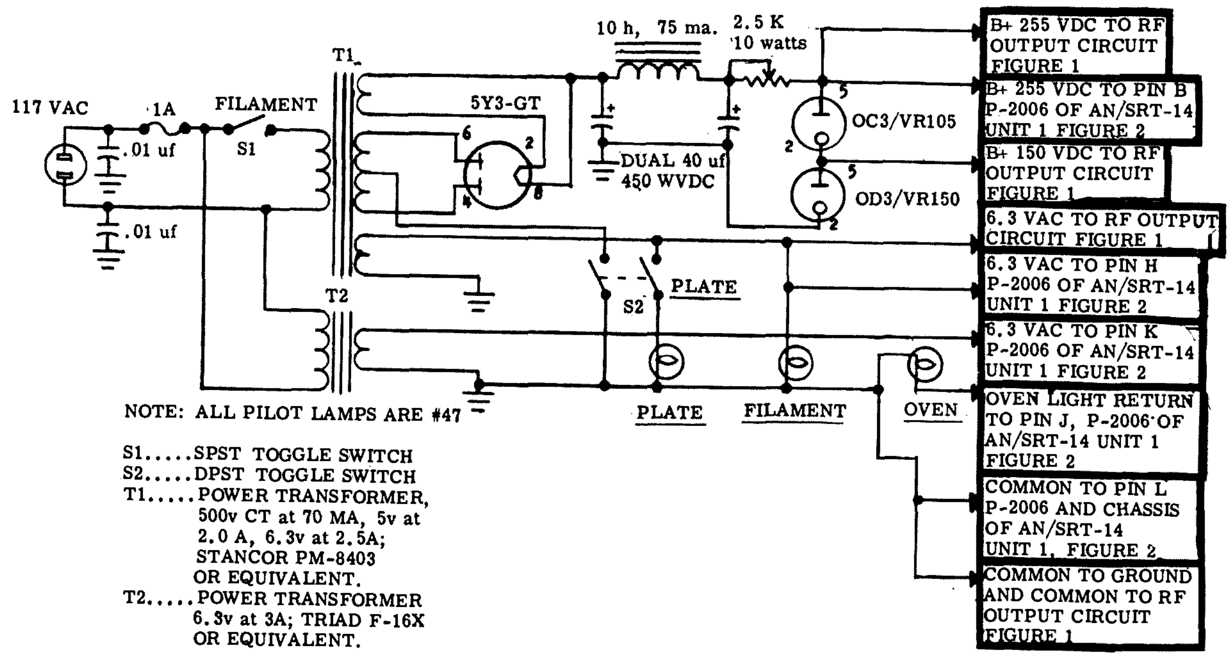


Fig. 2

Oscillator Unit has been widely distributed in MARS channels. These units have recently become available on the surplus market. RITCO Electronics of Annandale, Virginia has a very substantial stock of these units which are priced at under $25.00 Incidentally, some of the units on hand at RITCO use a James Knight crystal comparable to the Bliley unit described above.

The AN/SRT-14 Oscillator Unit requires a power source of 250 volts dc, a 6.3 volt filament supply and, preferably, a separate 6.3 volt crystal oven supply. Apply power, allow time for the crystal oven to stabilize and you have a 100 kc frequency standard with accuracy of 1.5 parts per million. However, those 100 kc harmonics become progressively weaker at the higher frequencies and are soon unusable.

The circuit shown in Fig. 1 solves the problem of high frequency attenuation and in addition provides 10 kc check points. The 10 kc



crystal standard is used to synchronize a dual-triode (V1), 100 kc multivibrator. The output of the 100 kc multivibrator is then used to synchronize a dual-triode (V2), 10 kc multivibrator. The output waveform of these stages has high harmonic content. A 6AU6 tuned rf output stage completes the circuitry of the rf unit. Switch S2 is provided to allow selection of 100 kc sine wave, 100 kc square wave or 10 kc square wave output. This switch also removes B+ voltage from the multivibrator stage or stages that are not used for any given output.

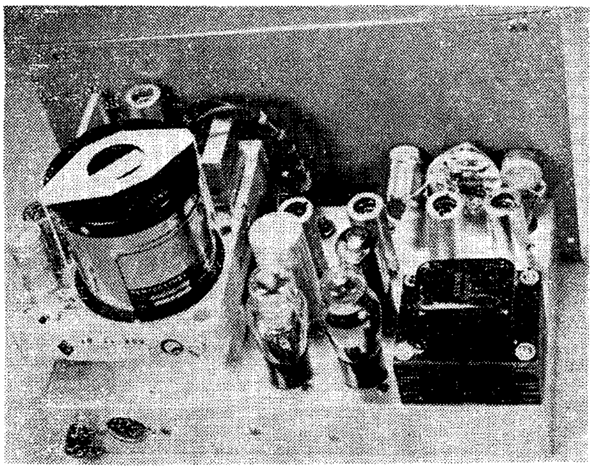
The output tuned circuit requires a few words of explanation. L1 through L4 provide continuous coverage from 3.3 to 60 mc. The 4,700 ohm resistor position is used for lower frequency output and C1 then serves as an attenuator. The coils used in the unit shown were tailored from surplus rf chokes with the aid of a grid dip meter. The 39th Edition of the ARRL Handbook, page 521, lists readily available commercial chokes which may be used unchanged to obtain similar coverage. This ARRL Handbook coil data is as follows:
L1..3.5-7 mc..10 uh National R-33 rf Choke
L2..6.5-14 mc.. 4.7 uh IRC CL-rf Choke
L3..15-30 mc..1.0 uh IRC CL-1 rf Choke
L4..30-60 mc..4 turns No. 20 Plastic Insulated Wire ⅜" Diameter.

Under certain conditions of measurement, it is difficult to pick out the frequency standard signal in a welter of heterodynes. This problem is minimized by tone modulating the output of the frequency standard. A relaxation oscillator using an NE-2 neon lamp generates an audio tone which is used to grid modulate the rf output stage. The sawtooth wave form of the modulating signal and the "dirty" modulation method provides unmistakable identification of the standard signal. Switch S1 disables the modulator after the signal is identified.

The power supply, shown in Fig. 3, is conventional. Power requirements are nominal and the seriesed voltage regulator tubes provide acceptable regulation. A separate filament type transformer is strongly recommended to provide oven heater current. Note that this transfrmer is connected between the ac line switch and the fuse. This permits the oven to run continuously which is essential if maximum stability is desired.

While any method of construction may be used, the unit shown in the photographs is a very convenient package. The cabinet is a Par-Metal CA-301 unit which is designed for

use with a 7" x 13" x 2" chassis. This chassis size permits all components and the AN/SRT-14 oscillator unit to be mounted without undue crowding. It will be noted that an extra tube, coaxial input jack and phone jack appear on the unit shown in the photographs. These components are used in a mixer/detector and audio amplifier which is not described in this article. Since practically all use of the standard is with the station receiver as the detector, description of this feature was not considered warranted.



The AN/SRT-14 oscillator unit is mounted on the top of the chassis and further secured to the front panel. Note the plug-in crystal oven which insures stability of the precision crystal unit.

The photographs show construction details. The pilot lights and switches secure the chassis to the front panel. The oscillator unit is then positioned with the crystal to the rear, flush against the panel. The four screws which hold a shield plate to the bottom of the crystal socket well are used to secure the unit to the chassis. Two screws are then used to secure the front lip of the assembly to the front panel. The BNC rf connectors shown in Fig. 3 are of the panel jack type which permit complete shielding of the output cables. Power connections to the AN/SRT-14 oscillator unit may be soldered directly to the existing connector pins or a mating connector, Winchester Electronics part MSE-14S-G, may be used.

After construction is completed, check your work. If all looks safe, throw the output selector switch, S2, to the 10 kc position and set the 2500 ohm voltage regulator dropping resistor to maximum resistance. Open the connection between pin 2 of the OD3 VN tube and ground and connect a 0-100 ma. meter to these points. Apply power and adjust the resistor for a reading of 20 ma. on the meter. Remove the meter and restore the connection.

Connect the 100 kc sine wave output, J1, of the standard to a receiver, using coaxial cable

to avoid pickup of other signals. Switch the receiver to the lowest frequency band and tune the receiver, with the BFO on. Signals should be picked up at 100 kc intervals. Make certain that the modulation switch, S1, is closed; throw the output selector switch, S2, to the 100 kc sine wave position and transfer the output cable from J1 to J2. Signals should still be heard at 100 kc intervals.

Leaving the receiver tuned to one of the 100 kc harmonics, switch the standard to the 100 kc square wave position. Now adjust the 100 kc LOCK control across its range. Unstable hash should be heard across most of the range but a clean, stable signal should be heard at one or more points. Leave the resistor adjusted to the center of one of these points and tune the receiver across the band. Signals should be observed only at the 100 kc points. If other signals are noted, readjust the control to another "clean" signal point and try again. When the multivibrator is correctly adjusted to 100 kc, switch the standard to 10 kc and go through the same procedure using the 10 kc LOCK resistor. The objective this time is to obtain exactly nine clean signal points between each pair of 100 kc points. When this is obtained, switch S2 through the three positions to insure that the multivibrators reliably lock in at the correct frequencies. If not, readjust slightly the appropriate lock resistor.

Tune in a signal from the standard and open the modulation switch, SI. Strong audio tone modulation should be heard. If the relaxation oscillator is not functioning or if a different modulating frequency is desired, adjust the value of the 1 megohm dropping resistor for the desired results. There is quite a wide variation in lamp characteristics so if you run into trouble, try changing the lamp. If desired, an NE-51 lamp may be used and a pilot lamp socket installed.

For the final test, switch the standard through the various output bands and tune in the signal on the receiver. It should be possible to peak the output signal by tuning the output tuning capacitor. After the unit is checked out, install in the cabinet. It will be necessary to remove the plug-in crystal oven to fit the unit in the Par-Metal cabinet shown. After the chassis is installed, open the top door of the cabinet and reinstall the crystal oven.

The completed frequency standard is an extremely worth-while addition to any station. Stability of the surplus oscillator unit is outstanding. Cost, using the AN/SRT-14 unit, is quite low and, for the laboratory quality involved, a real bargain. . . . W4WKM

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73
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RECEIVERS

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Wayne Grn, W2NSD
Editor, etcetera

March, 1963

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Leonard Tamulonis, W1MEL

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de W2NSD

never say die

FCC Flash

It seems probable that the FCC will soon release another 25 kc segment of the 160 meter band. Details next month.

Fly By Night Organization

We're really getting things set for the big European trip this fall. This is going to be a trip that will never be forgotten by anyone that signs up. The trip will take in London, Paris, Geneva, Rome and Berlin and will last for three weeks. We will be flying by chartered jet across the ocean and by the scheduled airlines within Europe. I have arranged the trip so that we will be flying on Sunday both ways. This is the best day to travel since there is little to do in most cities on Sunday, with the exception of Paris where we will be able to see the Louvre, the Eiffel Tower and the Flea Market on our first Sunday and in Rome where we will see the Pope and be blessed on our second Sunday.

The plane will leave Idlewild airport in New York at around 9 PM on Sunday October 6th and arrive at London airport the next morning. Chartered busses will take us to our hotel, where reservations will have been made for everyone. The rest of the day will be free for you to get settled in your room and venture out to see London. I highly recommend a book called, "Europe on $5.00 a Day" for the inside scoop on how to get around, where to eat, and where to shop. This book is fabulous and a must for any traveler who is in the slightest interested in paying European prices in Europe instead of U. S. prices. I have traveled all over Europe and kept my expenses for hotel and all meals within the $5.00 a day. This book is available through the Radio Bookshop (page 73) for $1.95 in the just out 1963/4 edition.

Tuesday will be spent in sightseeing, climaxed in the evening with a get together with the London hams for a buffet and some drinks. Invitations can be arranged at this time for visiting local hams with interests similar to yours. We'll try to plan meetings like this for every city. Remember, London is one of the best cities in the world for men's clothes . . . and the gals can load up on Aquascutum clothes at considerable savings over the U. S. prices.

I've tried to arrange the schedule to fit the cities. Paris has much doing on Sunday so we spend one of our two Sundays there. The hams in each city will be there to greet us and help to show us around. I'll have maps of the various cities for you plus some notes on places that I've found well worth visiting.

Paris is wonderful for shopping, with several big department stores and thousands of little shops. And the restaurants . . . wow! For instance there was the little left bank restaurant where Virginia and I both had delicious steak dinners, complete with big bottles of wine for only $3.50 for the two of us. A visit to the Lido nightclub is more expensive, to be sure, but I guarantee that you'll never forget that night as long as you live.

Geneva has been included, not only to give you an extra country, but to give you a taste of truly international shopping. The best of the entire world is imported here . . . goods you won't even find in New York City. Here you can visit the famous 4U1ITU station.

Then comes Rome. Those of you who are more athletically inclined are urged to try your hand at renting a Vespa or Lambretta and seeing Rome that way. There is lots to see . . . and lots to eat. You'll flip over Italian ice cream.

Berlin. One of the largest cities in the world and certainly the most dramatic is Berlin. The stores are crammed with marvelous goods . . . beautiful dresses, coats. The Berlin zoo is world famous. The Berlin subways are excellent. And then there is East Berlin. We will schedule a tour of East Berlin . . . something you'll be talking about for a long time to come.

There is nothing like going there and seeing it for yourself. On October 27th (Sunday) we fly from famous Templehof airdrome to Brussels and from there by Jet back to Idlewild.

Paris isn't the only city with famous night-clubs. The Resi in Berlin is world famous and you will never forgive yourself if you miss it. The last time I was there I spent about a dollar on drinks and had the time of my life. Every table has a telephone and a pneumatic tube. You can look around (providing the XYL is at another table or back home) and note the table number of someone that looks interesting. Write your note, put it in the tube and wait to see what happens. Sometimes a note comes right back and sometimes the phone rings for you. With a little courage you'll have a lot of fun and maybe even a dancing partner. The fountain show is worth the visit, even if the XYL won't let loose for an evening. Then there is the Golden Hufiesin, a night club where you can ride a horse on the dance-floor/riding-rink. I did it.

I'm trying to think of everything so you'll have a minimum of things to worry about. There'll be hotel reservations in all cities, complete with breakfast. You'll be on your own for lunch and dinner, except for hints I'll have for you and notes from the $5-a-Day book. This'll give you a lot of flexibility. I might suggest that you try at least one Chinese meal in each country you visit and be amazed at how something like this can vary so completely.

The trip will last three weeks and the total cost for the two-way jet flight across the ocean, commercial scheduled airline flight from city to city, all hotels, including breakfast, busses to the airport and hotels, and a tour of East Berlin will only be $550. This may go up a little bit if we have less than 150 on the trip, probably running $585. When you consider that the cheapest air rate to Rome normally is $630 round trip you can see that we have ourselves a bargain. We can take 150 on this trip and no more, so the first 150 reservations will have to be it.

If you want to go on this tour you must have at least one member of your immediate family as a member of the Institute of Amateur Radio and they must have been a member for at least six months before the trip. Send me your name, call, and $250 half payment (made out to the Institute of Amateur Radio) for each person in your family going to officially reserve seats. The balance will be due sixty days before blast-off.

This will be something that you will remember as long as you live. You may have other chances to get to Europe some day, but you'll

never have a chance to do it along with a friendly group of hams this way and you won't get to meet the DX hams en masse like this either. Forget the expense, even if you have to borrow a little or settle for a smaller car to make it, for this will be one of the best investments you'll ever make.

How come October? Many good reasons. Plane fares are a lot cheaper at this time of the year. Hotels are looking for customers after the summer rush is over. You can get better bargains everywhere . . . restaurants, stores, etc. We could never get our large group around during the summer. October usually is very pleasant in Europe . . . sunny and warm, but not hot. I'll give you some good dope on the best clothes to take when you sign up. You can do the whole trip with just one small suitcase.

Remember, first come-first served. Get those reservations in right away and don't take a chance on missing out on this wonderful opportunity.

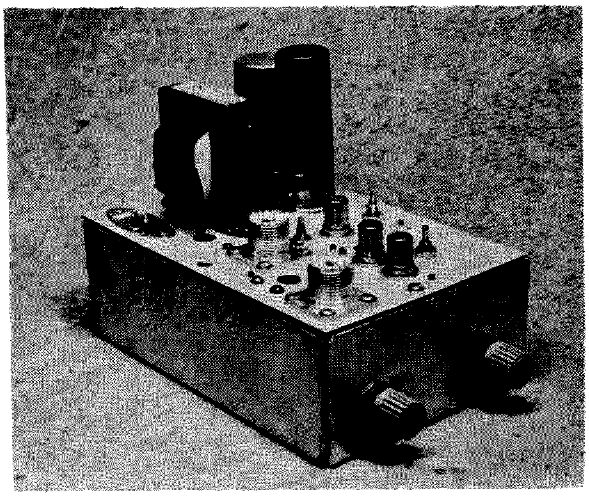
ACARN

I hate to keep grumbling about the same things every month, but whenever something I think is rotten comes along I frustrate until I see it put right. It bugs me. I pace around and worry. That stupid little mimeo machine out in California sending out hate propaganda under the titles of Anti-Communist Amateur Radio Network (ACARN), Amateur Radio Americanism Network (ARAN), and now the National Radio Relay League (NRRL) has the paint worn off my office floor. The brains out there must be paper-thin to accommodate such narrowmindedness.

National Radio Relay League indeed! The purposes of this organization include opposition to the U.N., breaking off all amateur communications with communist countries, and representation of American amateurs before Congress, State Department, Defense Department, FCC, and at international conferences. Let's take a good look at this interesting program.

The UN may be struggling along making a lot of mistakes, but it is the only world group we have. We should be making efforts to improve the UN and correct its deficiencies instead of trying to get rid of it when it doesn't do what we want. A couple of jet plane rides might convince even the die-hard isolationists that our world is pretty small today and not getting one bit larger no matter how far the

(Turn to page 76)



Corner view of completed pre-amp showing the bias control to the left, and the muting wafer switch to the right.

John Wonsowicz W9DUT
4227 N. Oriole Ave.
Norridge, Illinois

A new approach to nuvistors

Two Meter Pre-amp

NUVISTOR VHF pre-amplifiers achieved national popularity almost over night. Most two meter operators have one, are building them or are in the process of gathering components. The RCA 6CW4 is the most desirable little thimble ever to reach the hands of the VHF man and if used properly becomes a very useful device. Unfortunately many homebrewers mis-use the tempermental gem by applying too high of plate voltage or by inadequate shielding which results in too high of noise figure or worse yet, oscillations.

In designing this pre-amp many facets of circuit configurations were considered and the one most appealing in all respects is the grounded grid layout. This type of circuitry exhibits unusually low noise and has an edge on the cascode or the ordinary neutralized-triode amplifier. However, the voltage amplification does not come up to the latter circuits, so two stages must be used to bring it up to par.

In preliminary designs, many hours were spent in observation of the behavior of the 6CW4. Various tricks have been tried and evaluated and some of these are as noted:

One of the most contributing factors in the noise department is the application of plate voltage in excess of 50 volts. Although the gain per stage will increase with higher plate voltage, the circuit and tube noise goes up with it, so nothing is gained. Plate voltage between 25 and 50 volts seemingly gives the best signal to noise ratio and such voltage should be used in at least the first stage.

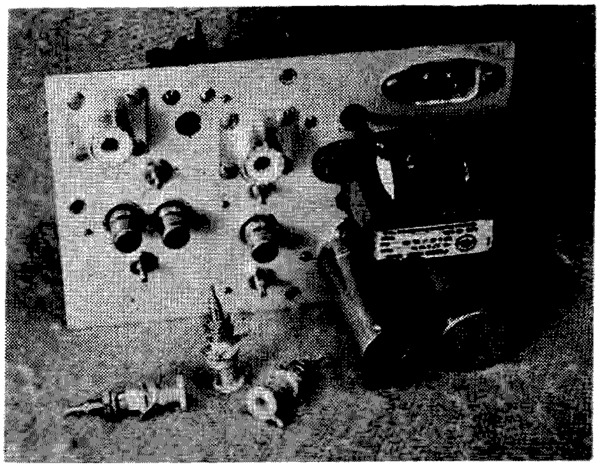
Another item well deserving of mention is the link coupling between stages for purer signal transfer. It's a known fact that capacity coupling between stages is a lot easier to deal with, but one must realize that in such coupling the spurious signals as well as electrical disturbance like to ride through to contribute to additional noise in the circuit. Link coupling used in this amplifier is quite simple to make, and the drawing shows how to modify the coil forms for securing such extra coil windings to the wire tabs.

Shielding between input and output circuits, as well as between stages is very important when using high gm. tubes, therefore it is of utmost importance that most effective partitioning be utilized in such circuitry to prevent uncontrolled regeneration, which eventually throw the stage into oscillation, piling up additional work in ferretting out such troubles for eradication.

One rather astonishing factor observed during experiments with the 6CW4 is that the thimble adapts itself beautifully for tandem element connection where two or more tubes can be tied together to realize an overall increase in gm. The sockets are so small that the increase in inductance and stray capacities when connecting elements in parallel play an

insignificant part in the tank circuit coils design. Tank circuits can be wound with high L to C ratios as though only one tube was used, and such high L to C ratio tuned circuits are desirable in broad band application of pre-tuned stages, especially in the pre-amp stage that must span 4 mc.

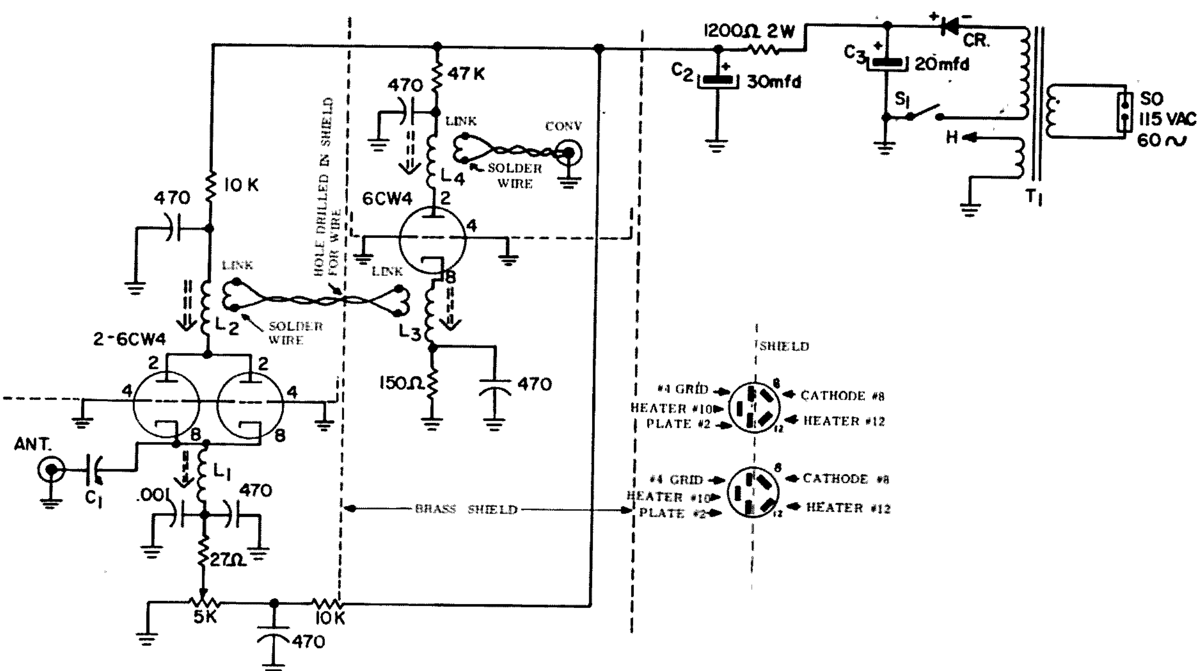
During these experiments, two nuvistors were connected in parallel to compare the effects and evaluate the difference between one high gm tube of 25000 u mhos and the combined gm of 25000 u mhos of the two 6CW4's. The circuit used is the herewith described grounded grid system in both cases and supply voltages varied. Each circuit was peaked and pruned for the highest gain, lowest noise and best sensitivity. Well, as you have guessed, the tandem nuvistors had an edge on the single tube. This is due to the fact that the elements of two tubes connected in parallel exhibit a lower plate resistance. Actually in such configuration the Rp is cut in half, and the gm is doubled, but the RL which in this case is the XL (the reactance of the tuned circuit at the operating frequency) remains unchanged. Appying these parameters in the votage ampification equation, it is apparent that higher gain can be realized from such an arrangement. This was further proven by removing one nuvistor from the circuit, re-peaking the stage and noting that approximatey 6 db attenuation resulted in gain and the sensitivity had dropped appreciably.



Top of plate chassis, showing placement of components. The three coils in the foreground are the type used in the amplifier.

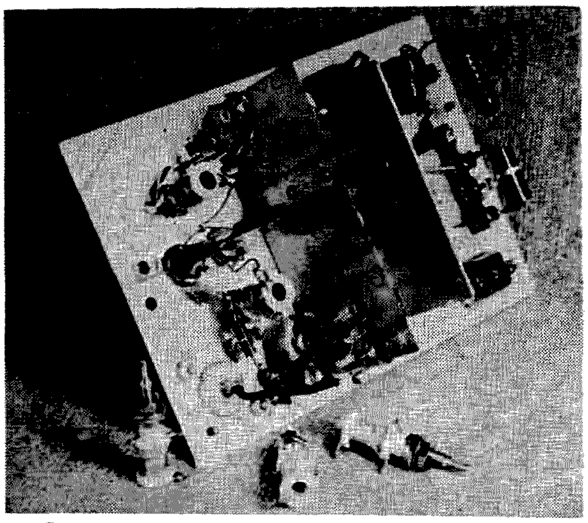
Another noise reducing idea that works nicely in a audio pre-amp was tried to further increase the performance of this stage. It is the application of dc to the heaters. This looked good in theory, but did nothing in practice, so it was discarded for the ordinary ac one side grounded system.

Last but not least, attention was centered on the input circuit to compare the various methods of antenna-to-cathode coupling. Considerable time can be consumed on such comparisons, but such time is not wasted if desired results are obtained. After many tries of tapping various turns on the cathode tank coil



T1—Stancor #PS-8415
CR—Silicon or selenium rect.
S1—Standby switch, Centralab type 1460
C1—5-30 mmfd ceramic var.

C2—30 mfd 150 volt
C3—20 mfd 150 volt
All other capacitors—RMC discaps
SO—TV type ac male conn.



Bottom view of the pre-amp showing placement of components and brass shields separating coils and socket pins.

and using a plain link, also a tuned link, the direct coupling to the high side of the cathode coil L1 through CI proved the best method. Needless to say, it is also the easiest in low impedance devices.

Construction

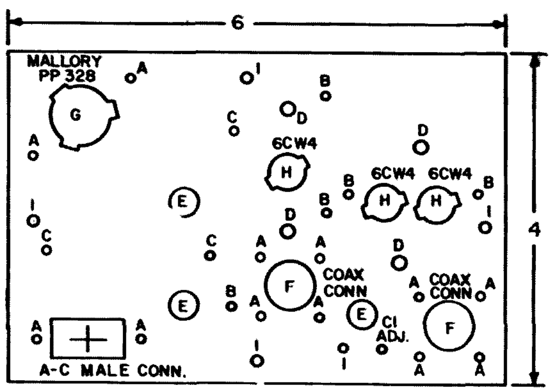
The chassis used in the final assembly is made of 1/16" aluminum stock and measures 4" x 6". A bud aluminum chassis 4x6x2 No. AC-431 serves as the shielded base. Using a plate for chassis has many advantages in punching and drilling not to mention the ease of soldering components in the hard to get at places. (Those of you that would like to duplicate this unit can obtain a paper drilling template for the chassis by mailing a self addressed stamped envelope to the author). The rear part of the plate houses the half wave power supply and the front part is used as the amplifier with input and output coax connectors. As seen in the photo, the power supply has a OB2 as the voltage regulator; this is not used in the final arrangement due to the low voltage required for good performance and voltage regulation is not required. The power transformer is a Stancor PS8415, rated for 125 volts at 15 ma. The heater winding is 6.3 volts at .6 amp. A silicon, or a small 65 ma selenium rectifier can be used in the half wave design. A stand-by switch is provided opposite of the rf gain control to mute the amplifier, if so desired.

As shown in the schematic, the 6CW4's are operating in a grounded grid configuration. The first stage carries two nuvistors for gm doubling and the second stage uses a single grounded grid nuvistor. Thin brass shields secured to the chassis plate by 2-56 screws and cut out for a good fit around the tube sockets, separate the cathode input circuit from the plate circuit. This shield also serves as a ground plate to which RMC ceramic disc cap capacitors, one side of the heater, and the grid of the 6CW4 in the related circuit are soldered to. Other shields made of the same material and fastened to the chassis plate isolate the coils from one another. These shields can be tied together by 2-56 screws and nuts or soldered together at the joints. Solder is preferable for a better contact connection.

Coupling from one stage to another is made through holes drilled in the shields and links are connected by a twisted wire fed through, as shown on the schematic. In this fashion any capacity appearing between stages or between tube elements is grounded to the adjacent shield, thereby eliminating capacity feedthrough of spurious signals.

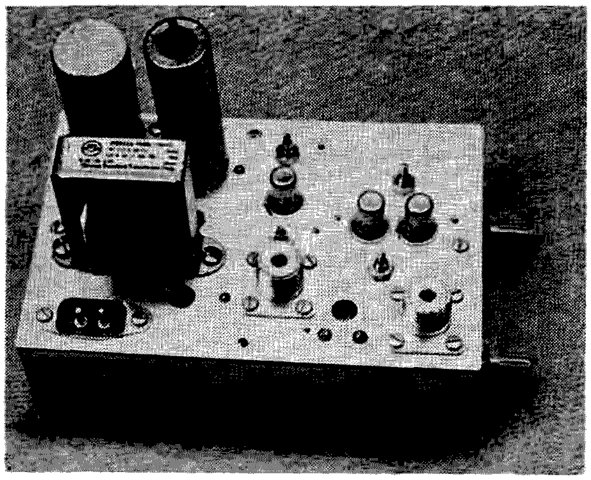
Adjustable bias control labeled as the rf gain is provided on the front part of the unit and connected with 3 wire flexible cable to cathode resistor, ground and B+. This control which is placed in the frount part of the Bud chassis is used to highly bias the first stage, thus eliminating over-loading and distortion on very strong local signals.

The coil forms used in this pre-amp are ceramic slug tuned forms obtained from J. W. Miller Co. and are labeled as 41A000CB1. Although various types of Miller coils can be used in this application, these particular coil forms are the best that I have used in such designs, because they are easy to modify. It is possible to put several windings on these small ceramic forms by simply inserting wire tabs in the moulded holes of the ceramic flanges to secure the windings. Three of the coils used in this pre-amp are modified by inserting such wire tabs for securing the ends



PRE-AMP DRILLING TEMPLATE
(TOP VIEW)

A—4-40 tap, B—2-56 tap, C—6-32 tap, D—3/16" drill, E—3/8" drill, F—5/8" punch, G—3/4" punched and cut out for cap., H—31/64" drill and cut out for sockets, I—#28 drill.



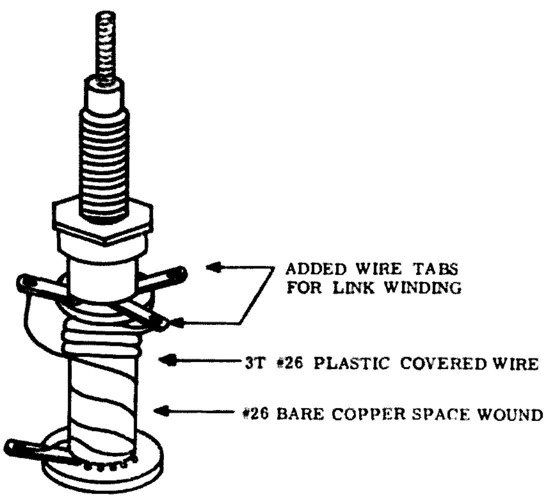
Top view of completed pre-amp. The two in line nuvistors to the right of the unit are tandem connected.

of the link winding. The tabs are made of No. 26 bare copper wire in form of a hair pin loop, pushed through the moulded holes in the top flange of the coil form and then bent downward and cut off to the desired length. You now have a very good tie point for the link coil which is wound with No. 26 or 28 plastic covered wire. These links are close wound on the upper section of the form (cold end of the coil) and then the main inductor is space wound below. See coil data for wire size and number of turns.

Performance

In evaluating the performance as an individual unit and also as a combined receiving set up, the following has been noted.

Sensitivity measurement with the aid of a calibrated attenuator on a Model 80 signal generator was better than .1 u volts.



L1-L2-L3-L4—J. W. Miller ceramic form 41AOOCB1
L1—5T #26 bare copper space wound (no link)
L2-L3-L4—5T #26 bare copper space wound below the 3T link winding

The gain of the bare unit was 28 db measured with the Model 80 calibrated attenuator and a Sylvania VTVM.

Noise figure measured with a Sylvania 5722 diode noise generator was under 3 db.

Tuning the Pre-amp

Most of the electronic enthusiasts do not own laboratory test equipment for precise testing and evaluation of their newly constructed, or acquired gear and must lean on the designer's findings for performance, specifications, method of tuning and operation. In this paragraph we will only state the method of tuning without laboratory instruments; the rest of comparisons must be made by aural comparison of associated gear and individually evaluated.

To proceed with alignment, first adjust all powder-iron cores in the ceramic coil forms approximately half way. Connect the two-meter antenna to the input coax connector, and the coax output connector to your two-meter converter. Tune your receiver until you hear a weak station, and then adjust L3 and L4 for maximum gain. After the signal is peaked, adjust L1, L2 and C1 for the best signal-to-noise ratio. That's all there is to it. Of course you won't be able to talk true performance specs, but you will have a receiving set-up that will dig deep-in-the-mud and bring out the signals with readable clarity.

My thanks to K9EPB, Howie Trieb for processing the pictures. . . . W9DUT

Letters

Dear Wayne,

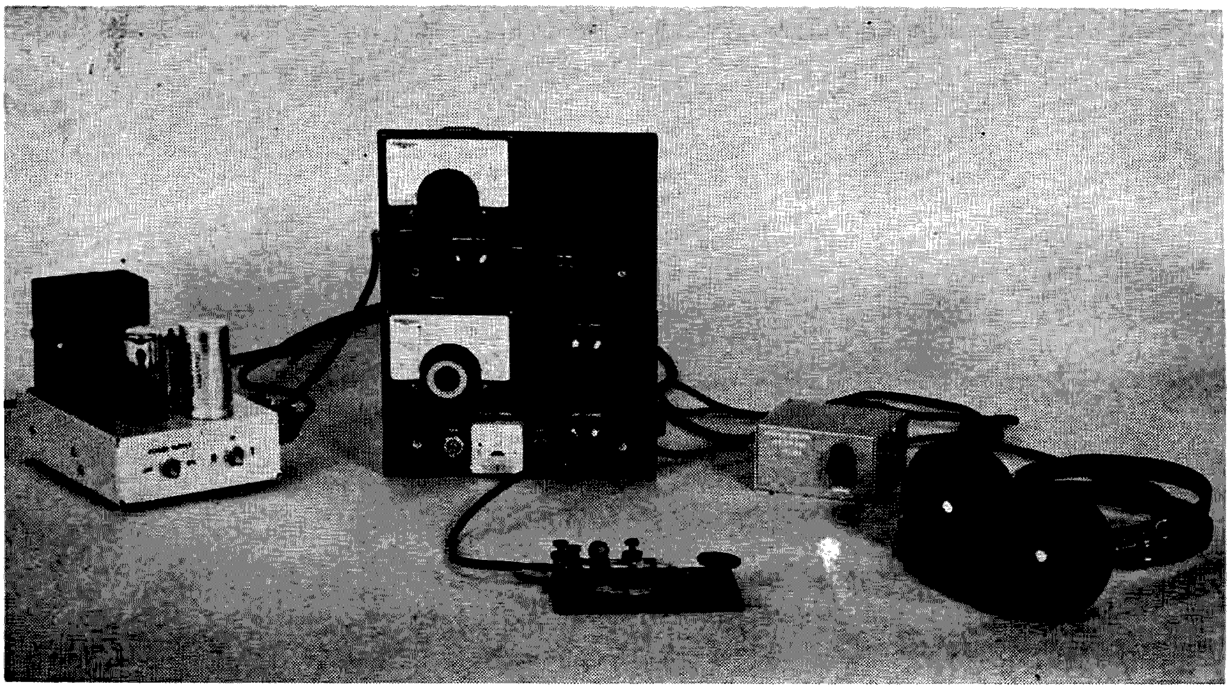
In the scope article, January 73 page 52, you should have mentioned that phosphors P1-2-4-5-11-15-20-24 are OK for monitors, but P7 has too long a persistance. Also, beware of bargains such as the 5FP—series that require magnetic deflection. In Fig. 13 it is not possible to operate the scope tube with both the deflection plates and the cathode at ground potential.

Harvey Pierce WØOPA

Wayne:

I have an old Howard Model 435A communications receiver which has been converted to Model 436A. If possible, I would like to get some service information on these models so that I can restore it to new condition.

Jack W. Riggs WA6KIH
1055 Via Granada
Livermore, California



Portable Ragchewer

David Brockman K6LJY
6211 Stearns St.
Riverside, Calif.

WHEN I FIRST conceived the idea of building a portable amateur station, I decided that it must meet three basic requirements: 1. low power consumption, 2. no TVI, and 3. simple. The rig was to be a rag chewer and not a "band blaster." This article is about such a station.

Transmitter

The transmitter uses a 6AU6 in an electron coupled Hartley VFO driving a 2E26 final to about 20 watts. To reduce loading effects, the VFO operates on 80 meters and doubles in the plate circuit to provide output on 7 megacycles. The final operates straight through into a conventional pi-net tank. A simple screen grid neutralizing circuit is employed to insure stability of the final. The final is cathode keyed; the VFO is not keyed to reduce chirp.

Receiver

Prepare yourself for a shock. The receiver uses a simple triode regenerative detector which is transformer coupled to two stages of audio amplification. Regeneration is controlled by varying the detector plate voltage. This receiver circuit produces a readable CW signal with an input of less than .2 microvolt RMS rf. It has a 6 db bandwidth of about 4 kilocycles. With the regeneration set for maximum CW sensitivity, the receiver will "pull in" or block on a signal of about 300 microvolts. This effect may be counteracted by increasing the amount of regeneration.

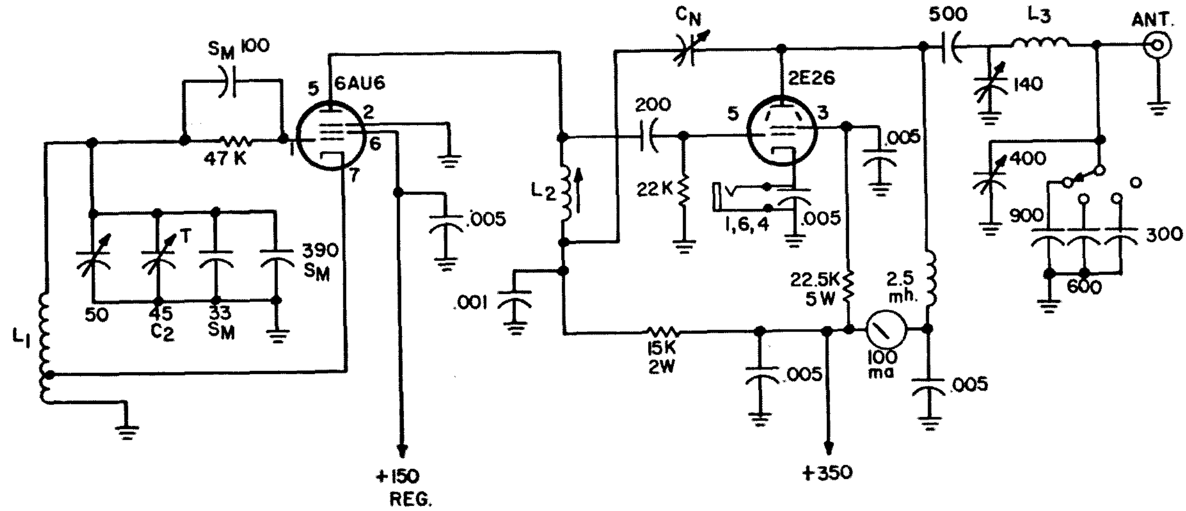
Construction

At a frequency of 7 megacycles, the circuit layout is not too critical. However, be sure to keep input and output circuits well separated electrically; use shielding if necessary. Also, be careful with transformer fields around the detector. Regen's really pull in the hum.

The VFO grid tank coil, L_1, is made from 22 turns of BW 3008. The tap is 7 turns from the ground end. This coil must be mounted rigidly. This may be done easily by cementing the coil to a short length of ½ inch plastic rod. The rod may then be secured to the chassis with a self tapping screw.

The VFO plate tank coil, L_2, consists of 45 turns of number 34 enamel wire wound on a ⅜ inch slug tuned form. In the circuit, stray and tube capacitance should allow this coil to be resonated around 7 megacycles. Check with a grid dipper.

The final tank coil, L_3, is made from 27



Transmitter

turns of BW 3015. This coil was supported by its leads between the tank tuning capacitor and a feed through insulator on the chassis.

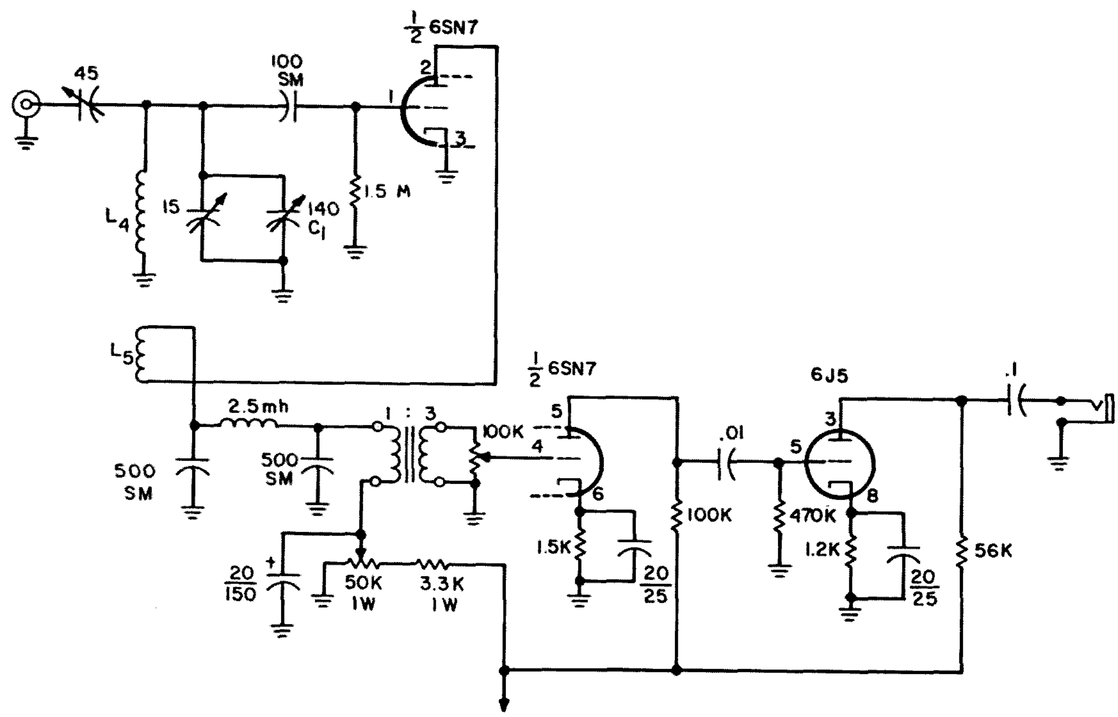
Because of the low final plate voltage (350 volts), the neutralizing capacitor, C_n, is a Centralab ceramic trimmer. This capacitor was mounted on the top of the chassis near the plate choke. Use short leads.

The receiver tank and tickler coils are made from a single length of BW 3011. L_4 has 21 turns and L_5 has 6 turns. Space these two coils ¼ inch apart and in line. In my model, these coils were mounted in a five prong plug in coil form for convenience in experimentation. A more rigid mounting, similar to the VFO coil, would be better. Keep these coils well away from metal surfaces and observe the proper phase relationship with the tickler leads. The lead adjacent to the ground end of L_4 goes to the interstage transformer.

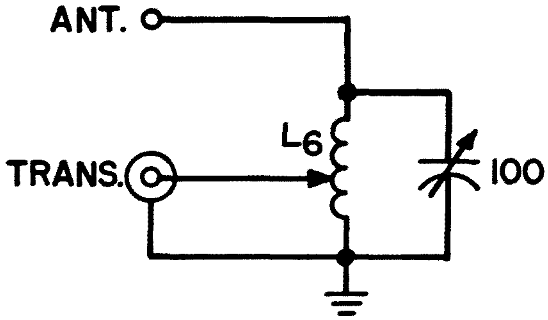
The method of TR switching is left up to the builder's own imagination. Here, I used a three pole double throw relay mounted in the power supply unit for both power and antenna switching. A VFO spotting switch was also included for operating convenience.

Power Supply

The station requires 300 to 350 volts at 75 mils for the final and 150 volts regulated at 25 mils for the VFO and receiver. The heaters require 6.3 volts at 2 amperes. These voltages



Receiver



Antenna Matcher

may be obtained from an existing supply, a Vibrapack or what have you. What ever the source, be sure it's reasonably well filtered.

Calibration

To prepare the transmitter for the air, first remove plate and screen voltages to the final. Next, turn the VFO on and listen for it in the home receiver. Using a known frequency source (home rig VFO), set the low end of the VFO dial with trimmer C_2. The VFO should cover the entire band. If it doesn't, increase the number of turns on coil L_1. Calibrate the dial. Now, with the VFO set at about 7.1 megacycles, couple a sensitive rf indicator to the final tank (grid dipper) and adjust the tank tuning capacitor and coil L_2 for maximum indication. Remember, no B+ on the final plate and screen. To neutralize, adjust C_n for minimum indication. With the plate and screen voltages applied, fire the rig up into a 15 watt light bulb. Touch up coil L_2 for maximum power output and she's ready to go.

To calibrate the receiver, advance the regeneration control until a soft hiss is heard. This indicates that the detector is oscillating and autodyne reception of CW is now possible. Set the low end of the receiver dial with trimmer C_1. During calibration, keep the regeneration control set just a shade past the point where oscillation begins. This is the receiver's most sensitive point. With an antenna connected, the antenna trimmer should be adjusted for best performance. The low end of the dial will probably have to be reset with C_1 to make up for the added capacity of the antenna. Once reset, the previous dial calibration should be OK.

Antennas

The transmitter's pi-network will load a coax dipole fine, however, it is not always convenient to "toss" up a dipole. The simple antenna matcher shown will facilitate the loading of end fed half wavelength wire antennas.

The coil is made of 25 turns of BW 3015. Adjust the tap and the capacitor for minimum SWR with a bridge.

On The Air

Using the rig described, operating portable from a college dorm with an end fed half wave wire 15 feet above ground, I have been able to make consistently good contacts all over the state. Solid "DX" QSO's with stations in South Dakota, Washington, and Alberta have been had during the evening "rush" hours on 40. RST reports received were 599, 579, and 579, respectively. No unfavorable reports have yet been received.

This little station works. Just remember that it's not a 75A4-KWS 1 and keep out of pile-ups and you will have no trouble working out. Have fun and look for K6LJY portable 6 on the low end. . . . K6LJY

PARTS KIT AVAILABLE

73 has a kit of parts available for both the transmitter and receiver sections of this combo.

Kit K6LJY-1 Rag Chewer Transmitter..... **$24.50**
Kit K6LJY-2 Rag Chewer Receiver......... **$16.50**
(postpaid in the U. S.)

Letters

URGENT

Dear Wayne,

Just solved two problems for you.

1. Limit international QSO's by U. S. amateurs to Extra Class licensees.
2. Limit all QSO's by Extra Class amateurs to international contacts.

These are just the solutions; I don't know what the problems are.

Ken W7IDF

Dear Wayne,

A minor correction on the diagram on page 28, January 1963. The emitter of transmitter Q2 should be returned to ground and not to the —10 volt supply.

Dave Cabaniss W1TUW

Dear Wayne,

I probably should be a bit more formal, but not knowing just what last name you are using this month, I trust you will forgive my familiarity.

The reason for this note?, to enlighten you on the reason we Hams subscribe to the various publications. I attended the Okla. State Convention and fell victim to the HARD SELL. While strolling among the exhibits a Stranger sprang over a table, grabbed me by the collar, dragged me over to the table (in spite of my screams and pleas) rubbed a subscription application to 73 under my nose and twisted my arm until I signed and paid. I've never regretted it. I think your Editorials and

comments are timely and enjoyable, the Writers and Authors qualified, the material well presented, in fact I think I'm getting more than my money's worth as is. I subscribe to several of the Amateur publications and I believe that you have forced an improvement in all of them. I agree with your thinking on ARRL (member here since 1932) and also your thinking on the NUTS from California. My sincere Best Wishes for your future success.

Clyde Steward W5HXK

(Guess I'd better get to more conventions and maybe study up on judo.)

Mr. Green:

I wish to wholeheartedly acknowledge and encourage the staff of 73 to ever increase their efforts of trying to educate the radio amateur in the "state of the Art," especially the technical aspects. It is sad that such a large proportion of us have neglected this responsibility for so long. We are indeed lucky that the FCC has not penalized the amateurs heavily as they might have. Perhaps we would be more quality conscious if they had.

I said that we have neglected a "responsibility." This needs emphasis and elaboration. To begin with, the amateur radio operation we enjoy is a privilege, and attached to it is a respective responsibility or obligation. But what is that responsibility? My definition may not be perfect, but it does carry some truth.

We were given his privilege, at a substantial monetary cost to taxpayers and added hardship to other users of "frequencies," because the government believed that the return would at least equal the investment. One of the most important returns is our contribution to the technical art but generally this has, for the last 20 years, been meager, i.e. in proportion to our size.

I do not advocate that all amateurs become engineers. What I do advocate is a much better balance of our duties. Communicators, contestors, fraternity, etc. we need. But competent technicians are needed even more, and rag-chewers we need much less.

Amateur radio may well be a dying privilege, even now. A great effort is needed to reestablish our usefulness. Your magazine, with its technical bent, is a step in that direction. With your help, and some others, I predict a great revival in that which is supposed to be the essence of amateur radio. Keep up the good work.

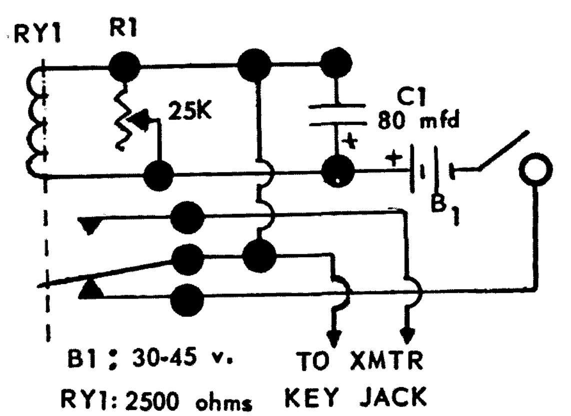
A. Kubicz W8IGJ

Wayne Green W2NSD

On page 20 of the April issue there is a description of an automatic dot maker. This appears to be a most interesting idea for a remote keying unit for a transmitter. I enclose a schematic for a unit that does the same job as the dot maker, a simpler one than the one submitted by Mr. Lee.

The circuit is simply a relay controlled by timing capacitor C_1 and speed controlled by resistor R_1. B_1 is a small 30 to 45 volt battery commonly used in transistor or low-voltage tube radios such as Burgess U30 or Everready #13 and relay RL_1 is a 2500 ohm SPDT relay such as Potter and Brumfield type LB-5.

Gary Budiansky WA2PAX



Infinite Impedance Antenna Match

Bill Driml W6NAT
252 East Los Angeles Dr.
Vista, California

INFINITE IMPEDANCE MATCH. What does this mean to an antenna? How do we know what happens when we put couple of pieces of tubing together insert coax cable and connect to the transmitter? We had to give it some kind of a name so Infinite Impedance was the closest we came to it.

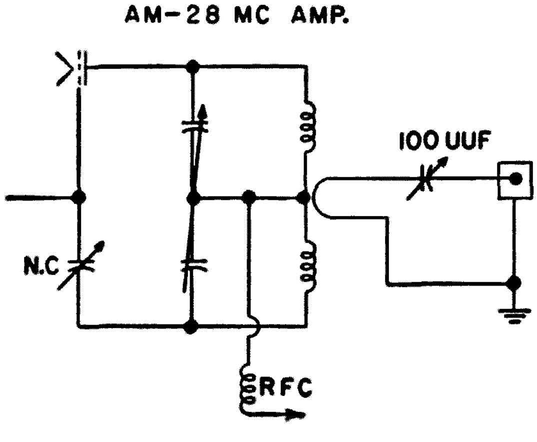
Here are a few characteristics of this match.

1. Weather has no effect on the coupling
2. Very easy to construct
3. Inexpensive
4. It certainly will radiate power
5. Can be used on any frequency
6. Receiving is excellent

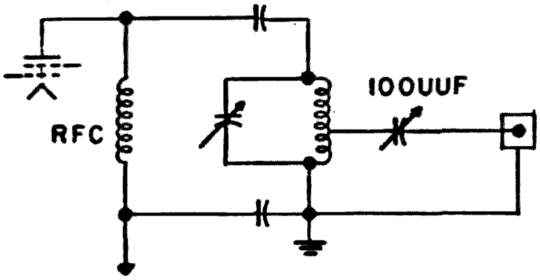
This coupling had been used on transmitters with powers from 5 watts to 1 kw input on 14 mc, 21 mc, 28 mc, 50 mc, and 144 mc at W6NAT, without any trouble matching the load to the antenna.

The coupling is made of RG8/U-52 ohm coaxial cable.

Construction of the match is very simple, remember this is ¼ wave length long. The formula is 468 over freq. in mc for ½ wave and divide by 2 for the ¼ wave.



After length has been determined, measure exact center and cut out about 1" insulation from the coax to the shield. Be careful in cutting so the shield would not be cut through. With the shield bare cut it through at the exact measured center and again be careful not to cut into the center insulation. Peel back the shield and gather the loose ends and twist them together. If the leads are too short solder #14 bare copper to the shield leads for further connections.



Now the same is done to the extreme ends, cut back the outside insulation about ¾" and peel back the shield, then cut the center insulation to the center conductor about ¾" back from the end. After this is done twist the shield wire over the center conductor and solder. Now if you look closely you will find this is a ¼ wave folded dipole.

Next procedure would be to attach the RG8/U chassis connector 83-1R to the center of the coax by soldering one shield lead to the center terminal of the chassis connector and the other shield to the ground portion of the same connector as shown in the diagram.

This connector is not necessary but it simplifies installing the antenna or disconnecting it. The RG8/U feed line can be soldered di-

rectly to the center shields without the connector. I personally would have the connector on.

Tape up all end connections with plastic electrical tape and also the shield leads on the connector so there will not be any shorts between the match and the tubing of the radiator. The match and the tubing are entirely isolated from each other.

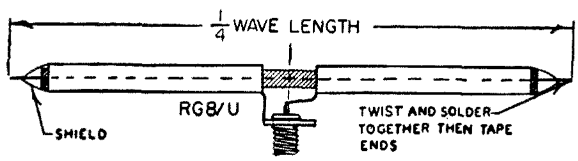
After calculating your antenna elements for your specific frequency and constructing the beam it is very simple matter to install this match inside your radiator tubing. The center radiator tubing should be spaced wide enough so as not to touch the chassis connector.

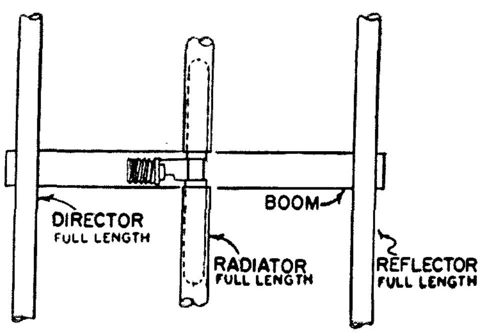
Some have tried this match just taping it on the outside of the tubing, providing the radiator is cut in the center. I prefer the match inside the tubing. All of the elements are held above the ground or metal boom with stand off insulators.

The coax RG8/U feed line can be any length to the transmitter and a variable capacitor of 100 mmfd or more is connected in series of the center conductor to tune out the reactance of the line. The circuit diagram shown is used at W6NAT's transmitters. With this combination the whole system is weather proofed. The reactance capacitor is mounted in the transmitter and only the coax lead to the antenna is out in the weather. This eliminates weather proofing containers, corrosion, loose connections to elements, etc.

Reports have been excellent on any frequency I have operated with this match. This infinite impedance match has been the simplest combination I have tried and I have tried many types. This match has been in use for over 15 years.

The credit is due to Edwin Dorchester W6DOF of Los Angeles, Calif. who designed this match. . . . W6NAT

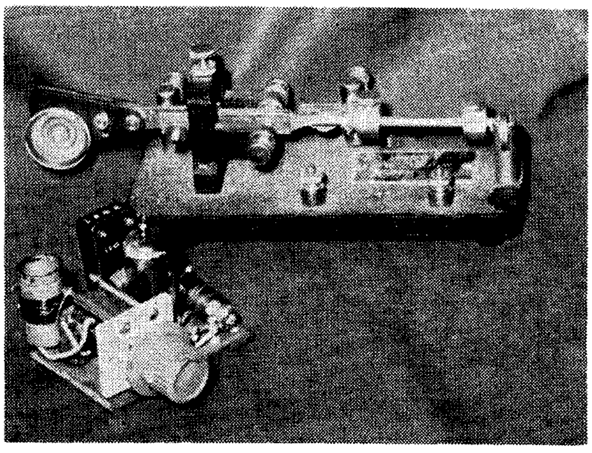


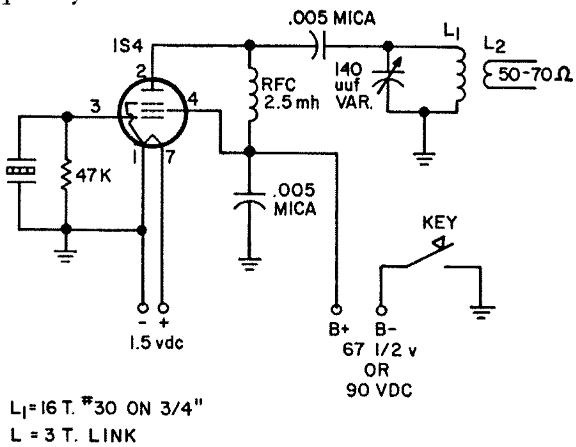


QRP Transmitter

Leonard Tamulonis W1MEL
73 Staff

The circuit shown here is for a teeny-weeny CW transmitter. In spite of its Lilliputian dimensions, it has worked over several hundred miles into Pennsylvania and Ohio on 40 meters from New Hampshire. The 1S4 can be loaded up to ½ watt with a 90 volt battery of the portable B+ type. The whole unit was constructed on a 2" x 2" square of Bakelite with 6" lengths of wire for leads to batteries and key. The little transmitter can be used on other bands besides 40 meters providing that the appropriate L-C circuit is used in the output section, and that the crystal operates straight through on frequency. . . . W1MEL



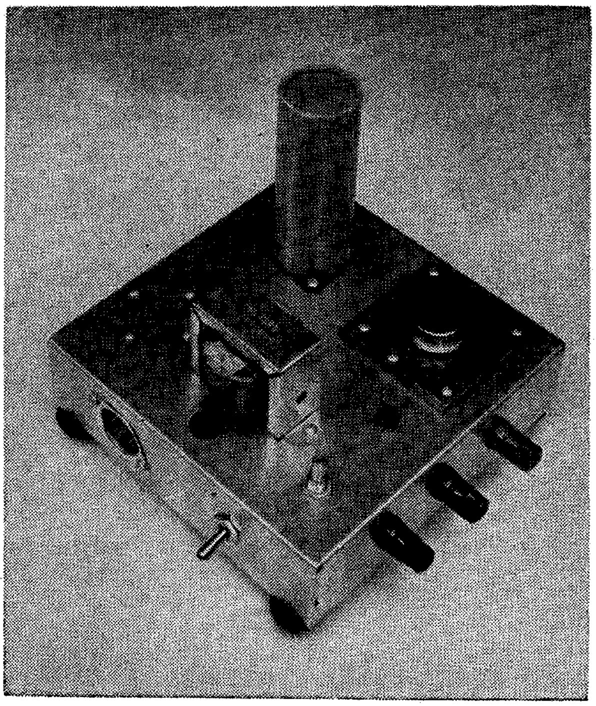


73 PARTS KIT

The parts for this little rig are available for immediate delivery. Tube, socket, variable condenser, rf choke, condenser, resistors, terminal strip, etc.

Postpaid in U. S. . . . . . . Kit W1MEL-1 . . . . $6.00

Order from 73 Inc., Peterborough, N. H.



Let's Regulate

Fred Haines W2RWJ

DID YOU KNOW that the garden variety power supply is now old-fashioned? Of course it's still possible to throw a transformer, a couple of diodes and a filter together and come up with a dc voltage output. But did you ever consider the downright bad effects which can arise from the use of such a jury-rigged circuit? Too often a well designed circuit works poorly or not at all simply because of an inadequate power supply, and more often than not, the real trouble is never diagnosed. In this day of transistors the need for better supplies is greater than ever before and this discussion treats of why and how.

The commonest troubles arising from the use of unregulated power supplies are motorboating and low-frequency distortion in audio and video amplifiers. Non-regulation can also be responsible for the untimely demise of transistors due to over-voltage; the use of transistors for fuses in this manner can be expensive! Many specific examples of improvement can be given for the electronically regulated power supply. For example let's assume we wish to build an electronic key. A regulated power source here would prevent any change in the sending speed which otherwise might take place if the line voltage changed. Some day, hook a Variac to a small filament transformer and supply heater current to the oscillator in your VFO from the transformer. Now check frequency stability as a line voltage change is simulated with the Variac. Surprised? It's possible to construct a 6.3 volt transistorized regulated supply for the oscillator heater which will hold at 6.3 volts within a few percent even though the line voltage changes from 90 to 130 volts! In short, these new supplies are so good if properly designed that they can exceed even batteries as direct current sources.

Line voltage variations aren't the only thing we're concerned with here, however. The internal impedance of a supply is extremely important. That is, if the circuit being supplied has a variable current requirement, then does the supply voltage remain constant at light and heavy current output? To find out the dc internal impedance of a power supply, simple procedure and Ohm's Law are all we require. Connect a dummy resistive load representing a light load current to the supply and measure the output voltage. Now substitute a lower resistance representing a high current drain and repeat the voltage measurement. The static or dc internal impedance then is simply the difference in the two voltage readings divided by the difference between the two current readings.

$$R = \frac{E1-E2}{I2-I1}$$

For example, a 20 volt power supply is loaded with a 200 ohm resistor. The voltage is read as 20 and the load current is measured at 100 ma or 0.1 ampere. The load is then changed to a 100 ohm resistor, and the output voltage is found to have dropped to 19

volts. The load current would be 190 ma or 0.19 ampere. Substituting in our formula,

$$R = \frac{20\text{-}19}{0.19\text{-}0.10} \quad \text{or} \quad R = \frac{1}{0.19}$$

and the internal impedance or resistance of the power supply is found to be 11.1 ohms for direct current. As a rule of thumb, a good regulated power supply will exhibit a dc internal impedance of well less than 1 ohm, and some have been built which go down to 0.005 ohms and less! So you see, the supply we used in our example was pretty miserable. The best part about all of this is that it isn't too hard at all to build supplies with internal impedances of less than 1 ohm.

Then, before we go on to power supply circuits, the ac internal impedance of a supply must be considered. In an ordinary unregulated circuit, the ac internal impedance is the reactance of the output filter capacitor, essentially. And the reactance of this varies directly with frequency, resulting in very high internal impedance at the lower frequencies and progressively lower as the frequency is raised.

Why is the ac impedance important? Well, if the supply has a high impedance at say

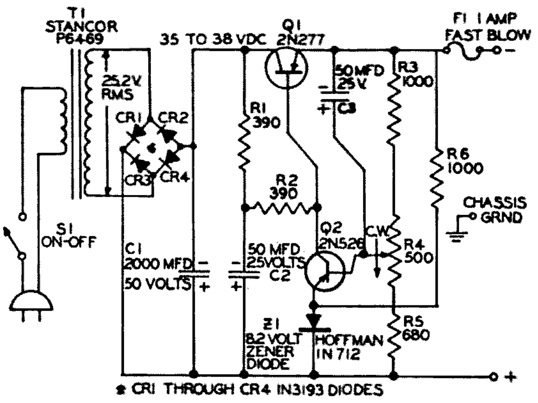


FIG. 1

20 to 30 volt 500ma variable supply. Note: for positive supply output jumper (−) to chassis ground, for negative jumper (+) to chassis ground. All resistors 1/2 watt.

300 cycles and an audio amplifier is to be operated from it, then common coupling between one audio stage and another will be found, and distortion at 300 cycles can result. Motor-boating is another example of high ac impedance, but this time at a very low frequency, where the reactance of the output filter capacitor has risen to a high value. Electronically regulated supplies have low internal impedances from zero cycles (dc) to several hundred kilocycles, thus simulating battery power supplies closely.

It is true that transistors can tolerate much less overvoltage or drift of supply voltages than tubes without being ruined or at least not operating at their best. This is another good reason everyone should have a good regulated power supply available in the shack if any transistor work is contemplated. The circuits to follow illustrate common transistorized regulated power supplies which have become standard in the industry of late. Circuits of this type can be designed for practically any voltage or current up to the 500 watt class, at which point the new silicon controlled rectifiers become much more efficient, but that's another article!

Referring to Fig. 1, note the similarity to the standard vacuum tube regulated power supply which has been described in the handbooks for years. Since we are using PNP transistors here it is required that we keep in mind the fact that they are "backward" from NPN transistors and vacuum tubes in their action; that is, a *negative* change of voltage on the base turns the collector current *on*. This is just the opposite from NPN transistors and tubes in which a negative voltage swing at the base or grid turns the collector or plate current *off*.

R3, R4, and R5 form a voltage divider across the dc output voltage of the regulator. The center pot connection transfers a voltage proportional to the output of the supply directly to the base of transistor Q2. Q2 compares the voltage sample from the pot with the stable zener diode reference in its emitter circuit. The zener diode, Z1, is analogous to a VR tube and you will notice it is fired through a resistor, R6, from the output of the power supply. Any change in the supply output voltage is thus sensed, compared with a reference, and amplified by Q2. The amplified change is applied to the base of the passing transistor, Q1, and serves to regulate its series resistance to result in a constant supply output voltage. Changes at the supply output can arise either from line voltage variations or from varying current demands of the load. Both kinds of change are ironed out by the regulator circuit.

The supply illustrated in Fig. 1 has a nominal output voltage of 25, with a range controlled by R4 of about 17 to 30 volts. The exact range is determined by the zener diode voltage, and this varies some unless a very expensive unit is used. The current available is 500 ma, and the circuit holds within about 0.2 volt with load current variations from 10 ma to 500 ma! The measured ripple as seen on a high gain oscilloscope is about 0.002 volt peak-to-peak at the full-load output of 500 ma! The internal dc output impedance was measured at 0.5 ohm, which compares favorably with our previous discussion which set up 1 ohm or less as the standard.

The circuit of Fig. 2 was designed to supply heater current to vacuum tubes such as in the VFO heater application previously mentioned. It will supply up to 0.75 amperes at 6.3 volts with excellent regulation and an internal d-c impedance measured at about 0.3 ohm. When this supply is delivering its full rated output

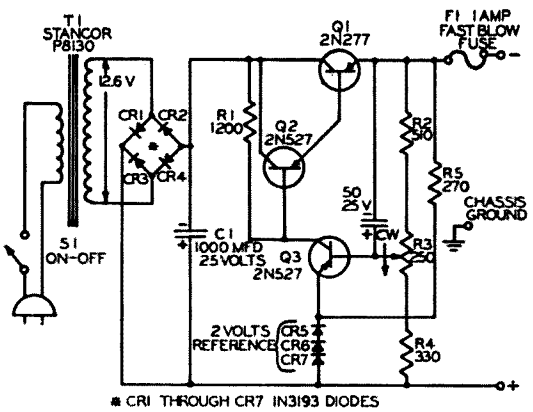


FIG. 2

A 6.3 volt 0.75 amp supply for tube heaters. Note: same note as Fig. 1.

current, a line voltage variation from 100 volts to 130 volts produces a variation of 0.2 volt at the output terminals.

Two interesting circuit variations are found in the 6.3 volt power supply. One is the use of a beta multiplier transistor, Q2. This hookup results in an increase in the d-c current amplification factor of Q1. If Q1 and Q2 separately have d-c current amplification factors of 10 (beta = 10), then hooked up as shown, the effective beta of the combination is 10 times 10, or 100!

The other circuit variation of note is the use of silicon rectifier diodes forward biased as reference elements. That is, a 2 volt zener diode could have been used instead of CR5, CR6, and CR7. The forward drop of a silicon rectifier is about 0.6 to 0.7 volt and holds fairly closely despite applied voltage changes. Three rectifier diodes in series to yield about 2.0 volts cost about half as much as a 2 or three volt zener diode. A good trick to keep in mind!

Now a few words about power transistors, such as the 2N277's used in these power supplies. The wattage dissipation ratings of these transistors are given with the assumption that the user understands the requirement for heat sinking. That is, the metal of the transistor itself does not have enough surface to radiate the heat developed by the transistor fast enough. You will notice then that these boys must be attached to a large mass of metal called a heat sink to carry off and radiate heat. Without a sink, Q1 in either power supply described here would destroy itself within a few minutes. A few mounting tricks must be known before a power transistor can be properly mounted.

Two methods of heat-sinking power transistors can be employed. The first is to mount the transistor directly to the heat sink metal without insulation and then to mount the heat sink to the power supply chassis on stand-off pillars to isolate the collector circuit from chassis ground. This is required because the case of the transistor is electrically connected to the collector of the transistor.

It has been found experimentally that the best simple heat sink for this use is a block of ⅛-inch thick copper about 2½-inches square, suitably drilled to pass the base and emitter leads through and to bolt the stud to the block. The other method of transistor heat sinking is to use the mica washer mounting kit supplied by some manufacturers with the transistor. The transistor is mounted to the metal block with the mica insulator between. The mounting stud then passes through a ¼-inch hole, is prevented from contacting the block by a fiber tube which is passed over the mounting stud, and another smaller mica washer is used under the mounting nut. Sometimes an anodized aluminum washer is used instead of the mica and is about equally as effective. The insulators above serve as electrical insulation, but pass the heat to the heat sink block. Cinch-Jones makes anodized washers, their type 2W-2 for the 2N277. The washers may be used as templates for drilling the required holes in the heat sink blocks. Be sure to drill large enough holes for the base and emitter leads so they will not short out as they pass through the block.

In any case, after you've decided upon a mounting method, check with an ohm-meter on the low-ohms scale to be sure the collector is not shorted somehoy to the heat sink material or the chassis. Perhaps the easiest way of all is to mount the transistor to the copper block directly, and space the block above the power supply chassis on insulators, as mentioned before. The disadvantage here is that it would be easy to short the heat sink accidentally to the chassis, and transistors do not last long when shorted. It has been found advisable to slip short lengths of spaghetti tubing over the base and emitter leads as they pass through the metal block to insure against shorts here.

One last caution; do not omit the fuse in the dc output lead of the supplies. If the output is inadvertently shorted, the power transistor will invariably be destroyed unless a fast blow fuse is used here. By fast blow is meant; not the delayed action slow blow type.

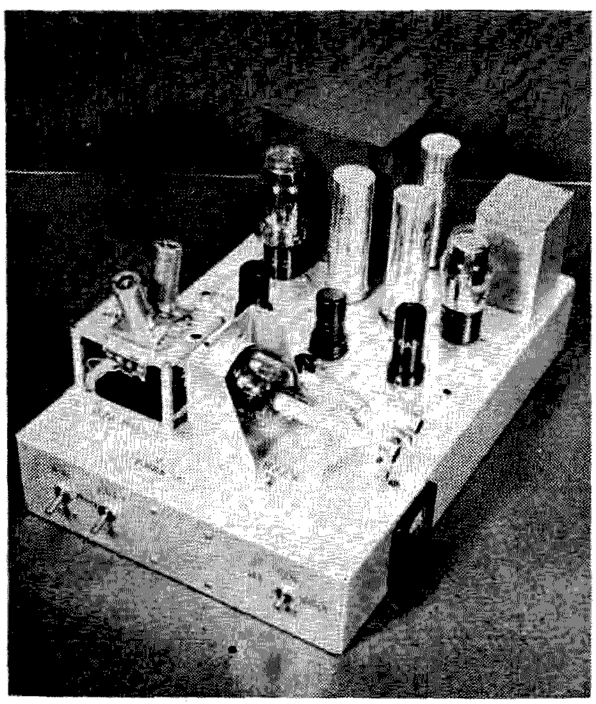
Transistorized regulated power supplies are easy to build, reliable, and produce consistently good results in the operation of transistor circuits. Throw away those batteries, and regulate!

. . . W2RWJ

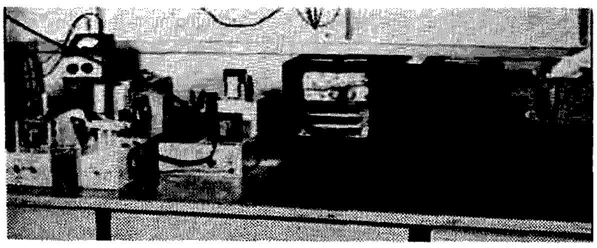
Amateur Television Transmitter

Louis Hutton WφRQF
2608 South Fern
Wichita 17, Kansas

SEVERAL MONTHS AGO a few CRU-59 AAE ATJ/ATK Iconoscope equipped cameras were obtained by a local amateur, and a short lived flurry of activity took place as a number of the cameras were put into operation in closed circuit systems. Successful transmission of pictures over short distances was accomplished then the interest subsided and the cameras were set aside to collect dust. WφWPQ Bill Briles and I decided to try our hand at amateur television and were able to acquire two of these cameras, although neither of the units were in operating condition. Surplus cameras of this type are presently available from several sources.[1] Information on ATJ/ATK camera conversion[2] and adjustment was located during the search through back issues of CQ and QST for Amateur Television construction articles. A power supply and Channel 5 closed circuit TV video transmitter was then assembled to check out the camera and become familiar with its operation and adjustment.



Transmitter, Power Supply & Video Modulator

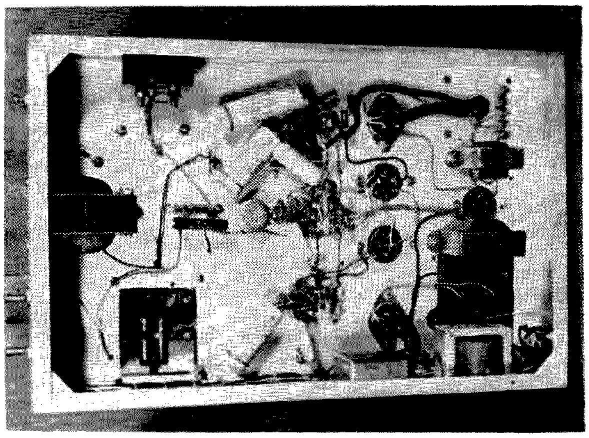


Slide Transmission Set-up

Television Transmitter

The next step in the project was to design and build a TV transmitter. Up to this point things had been pretty "cut and dried," but now the fun began! We were not able to locate any available information on a 432 mc TV transmitter. The first thing we knew we needed was a simple 432 mc oscillator. Crystal controlled multiplier stages took too many tubes and were expensive.

I obtained a junked APS-13 "Tail End Charlie" surplus radar set which worked on 432 mc. The receiver local oscillator plate line assembly was salvaged and used as the frequency controlling element of the push-pull 6J6 oscillator. The two tubes were mounted on a copper chassis at a canted angle as shown in the photograph. This was done so that the two grid connections would be close together. Short leads are a must at these frequencies. The two ends of the plate lines are attached to the 6J6 plates by short strips of .006 inch brass shim stock. When the oscillator assembly was wired, it was connected to a variable voltage power supply. A blue bead pilot light bulb on a short loop of wire was used as a dummy load. It was found that at 300 volts the oscil-



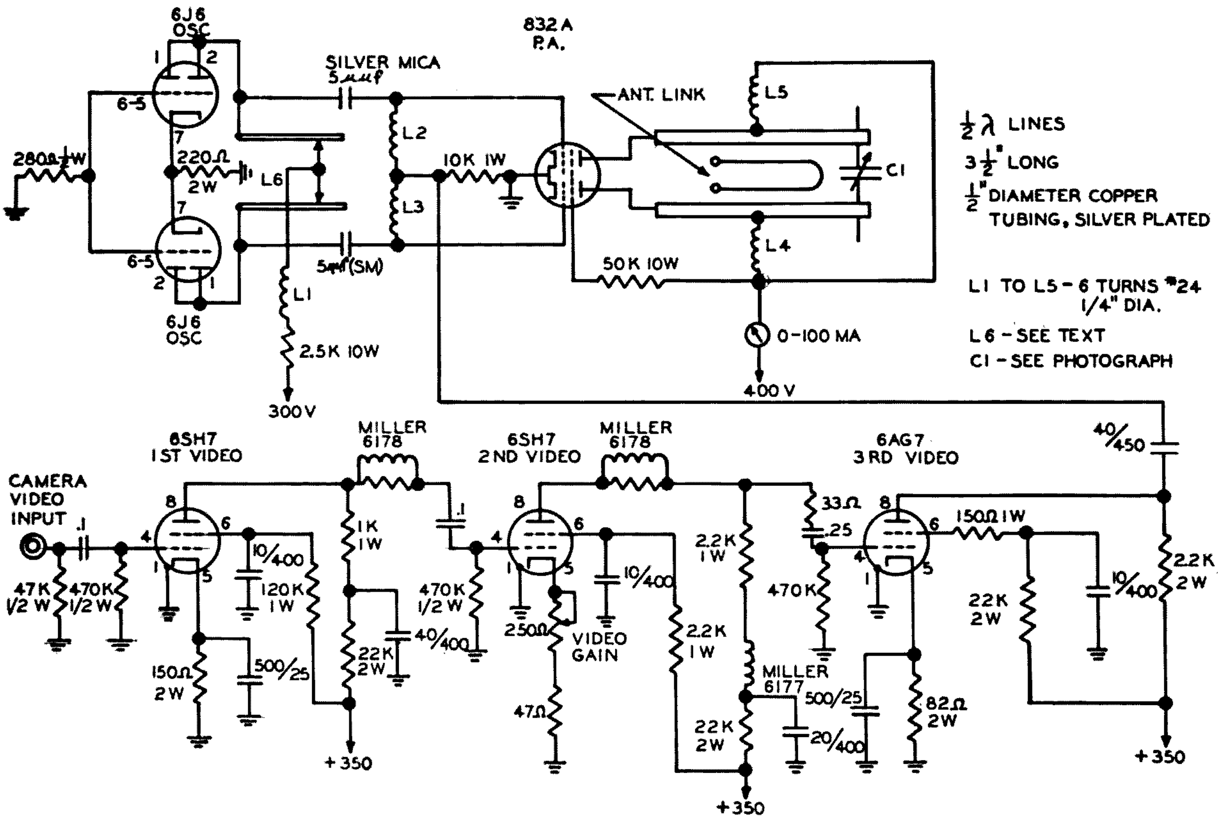
lator drew about 50 millamperes, which is about the safe limit in this mode of operation.[3]

The 832A final socket assembly was fabricated and mounted to the transmitter chassis, as shown in the photograph. The 832A grids were first coupled to the oscillator tank plate lines by running the 832A grid leads parallel to the oscillator plate lines. A pair of half wave, one quarter inch diameter copper, silver plated plate lines were constructed using a modified SCR-522 butterfly condenser to tune the end of the line. The hi-voltage was fed to the cold feed point through rf chokes. When this configuration was bench tested, the output was less than the 6J6 oscillator output. The grid coupling leads on the 832A were replaced with the assembly seen in the photograph. Link coupling was moved from the end of a redesigned plate line to the center, where it belonged. These modifications resulted in the increased output expected from the unit.

The 832A power amplifier is grid modulated by the amplified video signal. The video modulator is similar to the one used in the companion ATJ/ATK camera transmitter. The output tube was changed to a lower output type since my transmitter did not require that much video signal.

Antenna

The antenna used is a 32 element stacked collinear array. Careful attention is required in the construction of the antenna. Be sure that the phasing lines are of the same physical length, and that the phasing line polarity is observed. That is, both left hand bays are connected to the same side of the 300 ohm feeder line, and the right hand bays to the other side of the feeder. The output will be seriously reduced if this is not watched carefully. A quarter wave matching section was designed and installed in the line between the 300 ohm feeder and the phasing lines. This introduced more loss in rf output than it did good, so it was removed. WØWPQ built his antenna with the two bays mounted side by side. He found that the azimuth alignment of the antenna is much more critical than the stacked array. We have tried out yagis, and collinears and are convinced from our results that the stacked array is the best for this service from an economic,



ease of adjustment, and operational standpoint.

Operation

The complete ATV transmitting station is set up for transmitting either slides or live programs. The slide projector's 150 watt bulb was replaced with a 15 watt bulb and the lens barrel was extended so that it would focus directly on the iconoscope screen. Color slides, as well as pencilled messages on frosted glass slides are transmitted by this sytem. Live programs have been sent using two photofloods to light up the scene. One test included setting up a movie projector to see how movies came over the circuit. The lack of film sync made the pictures flicker like old time movies. Future tests will involve putting a 4.5 mc sound signal on the video channel.

. . . WØRQF

[1] U S #1 Electronics, Denson Electronics Corp., Barry Electronics Corp. and others

[2] Stoner, Surplus, CQ, May, 1957, p. 28

[3] Surplus Radio Conversion Manual, Vol. II, APS-13 Schematic and Conversion Data

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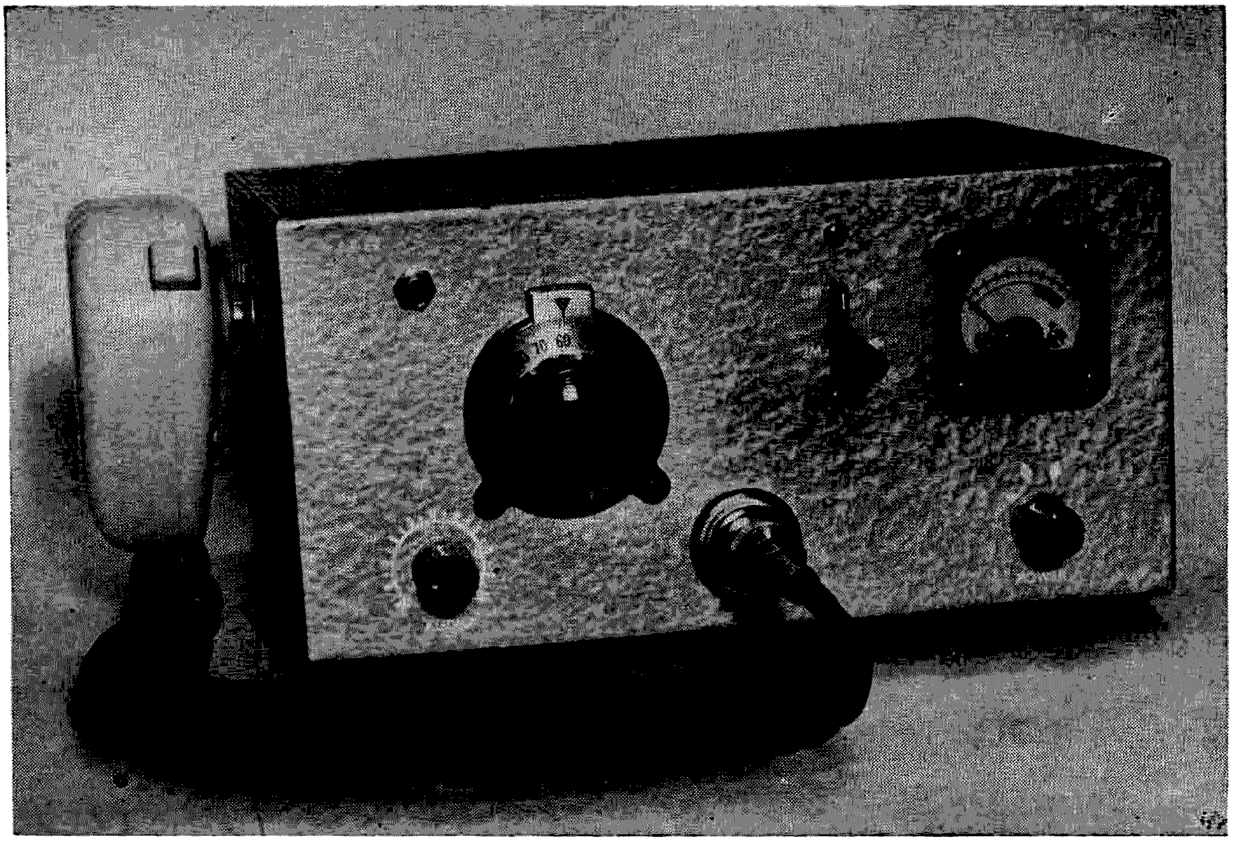
Dipper

WE'VE RUN SO MANY test articles on grid-dip meters that you may be getting tired of reading them. Unfortunately, though 73 has had GDO's on test, I've been using the Heath job for quite a few years since it is the only one I've owned. I'm a sucker for advertising though and when I read the ad for the new transistorized dipper in the December issue of us I spent a few days overcoming my natural resistance to spending money and finally ended up sending for one of the gadgets.

I talked myself into this one on the basis that though the Heath dipper works just fine, even after all these years and through several lendings, it does require a modicum of ac for livelihood and thus was not really ideal for use outdoors on antennas. The PEL job is transistorized, has the battery built right in, and weight only 14 oz. Further, it covers all the ham bands from 80 meters right on up through 1¼ meters, plus inbetween the bands. Even the $39.90 price ($29.90 in kit form) seemed reasonable.

It came. It works just fine.

Look up their ads or write to PEL, 214 Main Street, Hackensack, N. J.



Building a 6 & 2 Portable

Richard Juengel K8KDX/6
2325 Dartmouth
Palo Alto, California

HERE IS A COMPLETE 6 and 2 meter bandswitching transceiver designed to operate from either its built-in 110 volt ac supply or external 6 or 12 volt vibrator supplies. Using only 7 tubes, the rig fits into a 4½ x 9 x 7 chassis box and runs about 5 watts input on both bands. "Bandswitching" may not be quite the right terminology, since actually it is two complete transceivers in one, using common audio and power supplies.

Receivers

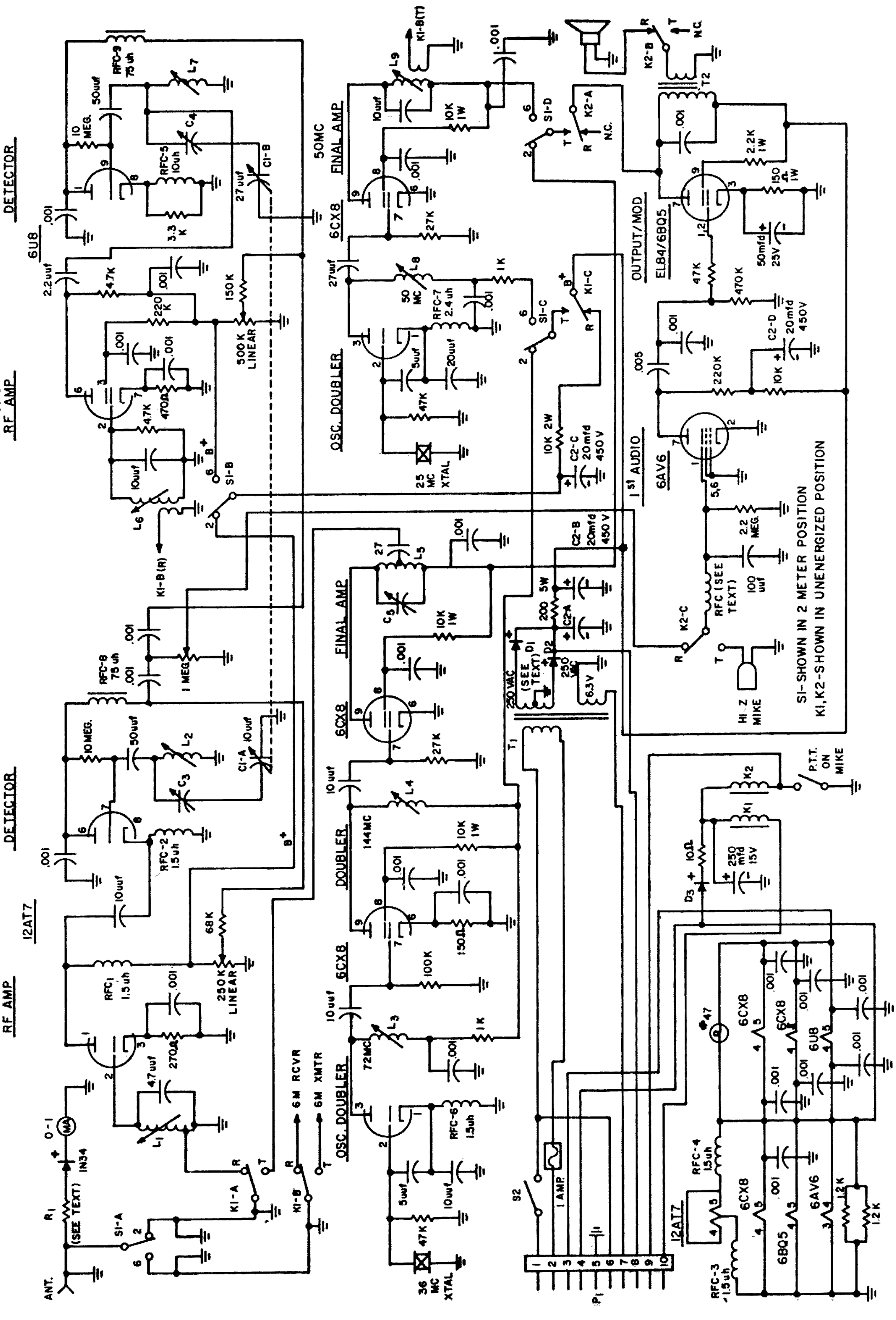
The receiver sections use superregenerative type detectors with rf stages ahead of them to eliminate several undesirable characteristics of superregens. They are patterned after the rceivers used in the Heath "Twoer" and "Sixer," but using tubes more likely to be found in the average hams junk box.

The two meter receiver used a 12AT7, one section operating as a broadband rf stage, and the other as the superregen detector. Similarly the 6 meter receiver uses a 6U8 with the pentode section used in the rf stage and the triode section in the detector. The main purpose of the rf stage is to provide isolation between the detector and the antenna, to prevent radiation and "suck-out" effects. Both receivers are very smooth operating and provide usable sensitivity down to 1 uv or less.

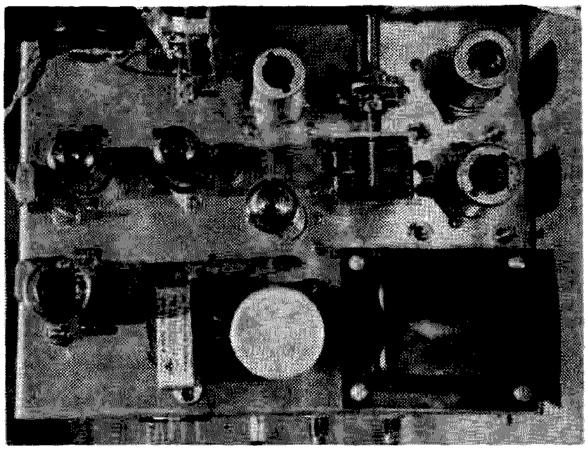
Transmitter

The transmitter sections use 6CX8 pentode/triode type tubes, two being used in the 2 meter transmitter and one in the 6 meter section.

The 6 meter transmitter uses 25 mc overtone crystals in a colpitts oscillator circuit. The oscillator operates at 25 mc and doubles to 50 mc in the oscillator plate circuit. The pentode section operates straight through on 6 meters.



DETECTOR
6U8
50MC RF AMP
DETECTOR
12AT7
144MC RF AMP
50MC FINAL AMP
6CX8
OSC. DOUBLER
FINAL AMP
DOUBLER
6CX8
OSC. DOUBLER
OUTPUT/MOD
EL84/6BQ5
1st AUDIO
6AV6
S1-SHOWN IN 2 METER POSITION
K1,K2-SHOWN IN UNENERGIZED POSITION
HI-Z MIKE
P.T.T. ON MIKE
6M RCVR
6M XMTR
ANT.
25 MC XTAL
36 MC XTAL
1 AMP



Top view showing layout and parts placement. Band selector switch can be seen in upper left hand corner, next to the meter.

In the 2 meter transmitter 36 mc overtone crystals are used in another colpitts oscillator circuit, doubling to 72 mc in the oscillator plate circuit, then doubling to 144 mc in the pentode section of the same tube. The pentode section of the second 6CX8 operates straight through on 2 meters. The triode section of this tube is not used.

Audio

The audio section serves as both the receiver audio, and modulator for the transmitter. An EL84/6BQ5 type tube is used because of its low drive requirements. The preamp stage is a 6AV6 which provides more than enough drive for the 6BQ5. The output transformer serves also for the modulation choke in this conventional heising modulator. The rf choke shown in series with the grid of the 6AV6 is actually a couple of ferrite beads slipped over the wire. These can be made by carefully drilling a hole through a section of ferrite material obtained from a coil core or loopstick. A conventional rf choke can be used instead if preferred.

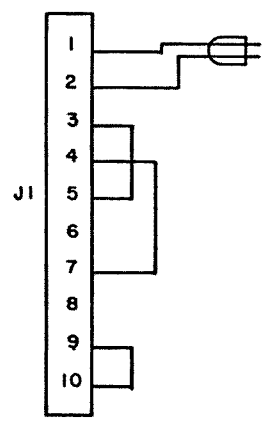
Construction

The rig is built on a California Chassis Co. LTC-464 chassis box which measures 4½x9x7. It is not recommended that anything smaller than this be used as the rig is quite compact as it is.

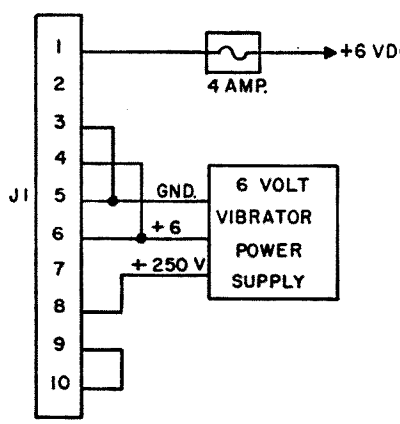
The general layout can be seen from the illustrations, although this can be altered to suit your fancy as long as things are arranged to provide the shortest possible lead lengths. The dual section 10 mmfd 27 mmfd tuning capacitor shown was obtained from industrial surplus. It is made by the Radio Condensor Co. and bears their part number R/C 273 011, 207, and may be available from them. If not, a small dual section transistor radio variable should be able to be modified to do the job, such as the Lafayette-MS-261. The capacitor used has two plates in the front section in both the rotor and stator and four in the rear section with about a 1/16th air gap between plates. The power transformer used also was surplus, but anything providing 500v C.T. at 70 ma, and 6.3 vac at 3 amps should do the job. Mine measures 2½ x 3. Start construction by mounting all parts and drilling all holes first. It is advisable not to start any wiring until all major parts that require mounting are at hand.

The coils are all wound on ⅜ slug tuned ceramic forms. Notice that the coil in the 2 meter detector is used with the slug removed. Tuning is done by squeezing the turns of the coil together.

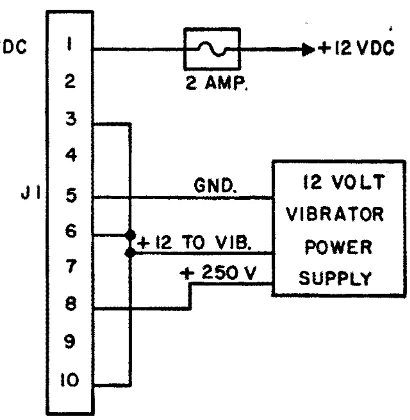
Start wiring with the audio, power supply, and switching circuits first. Then the other



110 VOLT AC
PLUG CONNECTIONS

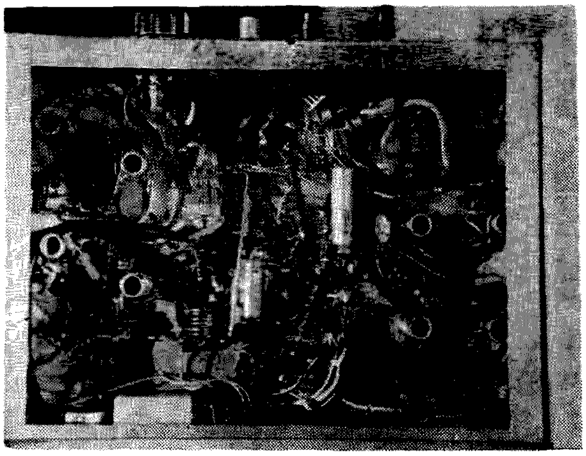


+6 VOLT DC
PLUG CONNECTIONS



+12 VOLT DC
PLUG CONNECTIONS

Note: For operation from a positive ground 6 volt system, it is necessary to reverse diode D3, and the 250 MFD. filter capacitor.



Under chassis view showing parts placement. The two receiver sections are at the right, the audio in the center, and the transmitter sections to the left. Sharp eyed readers may notice the two different relays used, which was an earlier arrangement.

sections can be checked as they are completed. Before testing check the coils with a grid dip meter and set them on frequency. It may be necessary to prune them slightly if your layout differs from mine. Don't forget to put in those filament bypass capacitors.

Testing

With a grid dip meter adjust the detector coils to cover the whole band with a slight overlap at each end of the tuning dial by adjusting the coil and series tracking capacitor as described in the ARRL Handbook. With power applied and the bandswitch in the proper position, advance the regeneration control for the receiver being tested until you hear a "pop" followed by the familiar rushing noise. This control should be set just to the point of regeneration. Check to make sure it stays in regeneration throughout the tuning range. If not, advance the regeneration control a bit further until it operates smoothly across the whole band. If you have any difficulty getting it to regenerate smoothly, try experimenting with the number of turns on the rf choke in the cathode of the detector, or in the case of the 6 meter receiver, the value of the choke and its shunting resistor. If a whistle is heard, such as when the regeneration control is set too high, try lowering the value of the 50 mmfd capacitor connecting the grid of the detector to its tuned circuit. However, if the parts specified are used no difficulty should be encountered. If a signal generator is available, it may be used to final tune the detector for proper coverage and to peak the rf amplifier stage. Some pulling of the detector may be noticed when tuning the rf stage. Be sure to use a very small signal to prevent overloading and misalignment of the detector. Signals down to 1 uv should be readable if all is well.

Transmitter Alignment

Connect a #47 pilot lamp to the output of the transmitter after setting all coils to approximate resonance with a grid dip meter. Adjust the oscillator coil for maximum voltage on the grid of the final, using a VTVM with an rf choke, or 100k resistor in series with the probe. Now adjust the final tank, and position of the link or tap, for maximum brilliance of the pilot lamp connected to the output. Touch up all adjustments for maximum upward modulation with a tone applied to the mike input or when you whistle into the mike. Select a value of resistance for the meter circuit to give a convenient reading on both bands with the rig connected to the antenna to be used. The meter provides a reference reading that can be used to tell if the transmitter is operating properly.

The rig is designed to operate with a two band antenna using a single feedline such as the Poly-Comm, or Hi-Par Halo, for mobile operation or one of several available beams for fixed operation. It may be modified to use separate antennas if desired by eliminating the connection to the bandswitch and running the outputs to two separate antenna connectors.

General

If desired all three power cables can be constructed to provide operation from 110 vac, and 6, and 12 vdc, with the proper vibrator power supply. The circuit is wired such that the vibrator supply is controlled from the switch on the front panel. Vibrator supplies such as the Heathkit should work very well, or one can be constructed around the Lafayette HP-234 Vibrator transformer using the circuit supplied with the transformer. The cost of the rig can be reduced somewhat by replacing the two relays with a 6PDT slide-switch, such as the Lafayette SW-99 at the expense of eliminating the push to talk feature. If operation from all three voltage sources is not needed, some simplification can be accomplished here also.

Although this rig does not represent the ultimate in VHF gear, it does provide very good local coverage and is ideal for mobile or net operation. It should prove to be an excellent club project also. New and better things are now in the works around here in

(Turn to page 38)

(6 & 2 Portable from page 36)

the way of 6 and 2 meter transceivers, so in the meantime, have at it fellows and good luck.

K8KDX/6

PARTS LIST

C—Dual section 10 mmfd variable (see text)
C2—20-20-20-20 mfd 450 V electrolitic
C3—1-10 mmfd plastic trimmer, Centralab 829-10
C4—7-35 mmfd ceramic trimmer, Centralab 820-c
C5—2.3-14.2 mmfd variable, Hammarlund 160-107
RFC-1, 2, 3, 5, 6,—1.5 uh, J. W. Miller 4604
RFC-5—10 uh, J. W. Miller 4612
RFC-7—2.4 uh, J. W. Miller 4606
RFC-8, 9—75 uh, J. W. Miller 4631 or equiv.
K1, K2—3PDT 6VDC relay, Potter Brumfield KM-14D (see text)
T1—Power transformer 500V C.T. at 70 ma 6.3V at 3 amp. (see text)
T2—Audio output transformer 2K primary to 4 ohm secondary, Stancor A3876
S1—4PDT lever type switch, Mallory 6242
S2—AC line switch rotary type
P1—Jones P-310-AB
J1—Jones S-310-CCT
MA—0-1 ma DC 2 inch meter
*TAL—3rd. Overtone, International Crystal FA-5
D1, D2, D3—Silicon rectifiers, LaFayette SP-241
L1-L4, L6-L9—3/8 ceramic coil form, J. W. Miller 4400

*Note—These crystals are calibrated to operate at anti-resonance and will be from 1 kc to 2 kc low in frequency when operated series resonance in this circuit.

COIL TABLE

L1—3½ turns No. 20 bare, on 3/8 ceramic S.T. form
L2—3½ turns No. 20 bare. on 3/8 ceramic S.T. form (slug removed)
L3—4 turns No. 24 E. on 3/8 ceramic S.T. form
L4—4 turns No. 18 bare on 3/8 ceramic S.T. form ....
L5—6 turns No. 18 bare, air core wound 3/8 dia. 3/4 long. Tap at 1 turn
L6—6 turns No. 24 E. on 3/8 ceramic S.T. form with 2 turn link
L7—8 turns No. 24 E. on 3/8 ceramic S.T. form
L8—5 turns No. 24 E. on 3/8 ceramic S.T. form
L9—6 turns No. 24 E. on 3/8 ceramic S.T. form with 2 turn link

Mode Switch for the Eico 720 and 730

James Demler WφDSU

THE EICO 720 transmitter and 730 modulator make a fine transmitting combination, but there is unfortunately no built-in provision for rapid switching from CW to AM. Here is a simple modification requiring only a 2PDT toggle switch and some wire (lamp cord is fine) that will enable you to incorporate a CW-AM switch in the 720-730 pair. It is assumed that the 730's B† is controlled by an external relay as this makes for good one switch

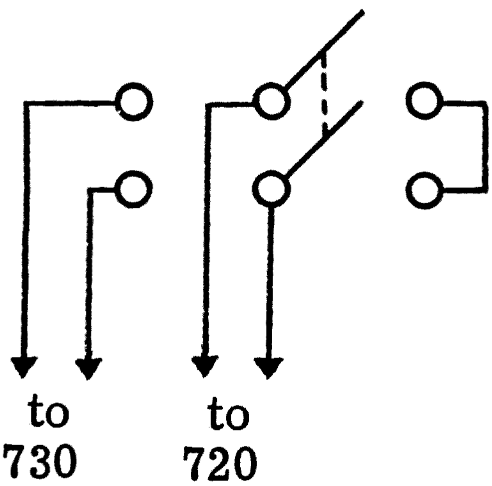
operation when switching from transmit to receive besides being necessary for the installation of this switch. This being true, the "plate supply" switch on the 730 serves no purpose. By removing this switch and replacing it with another we can add a "CW-AM" switch to the unit. Here's the procedure:

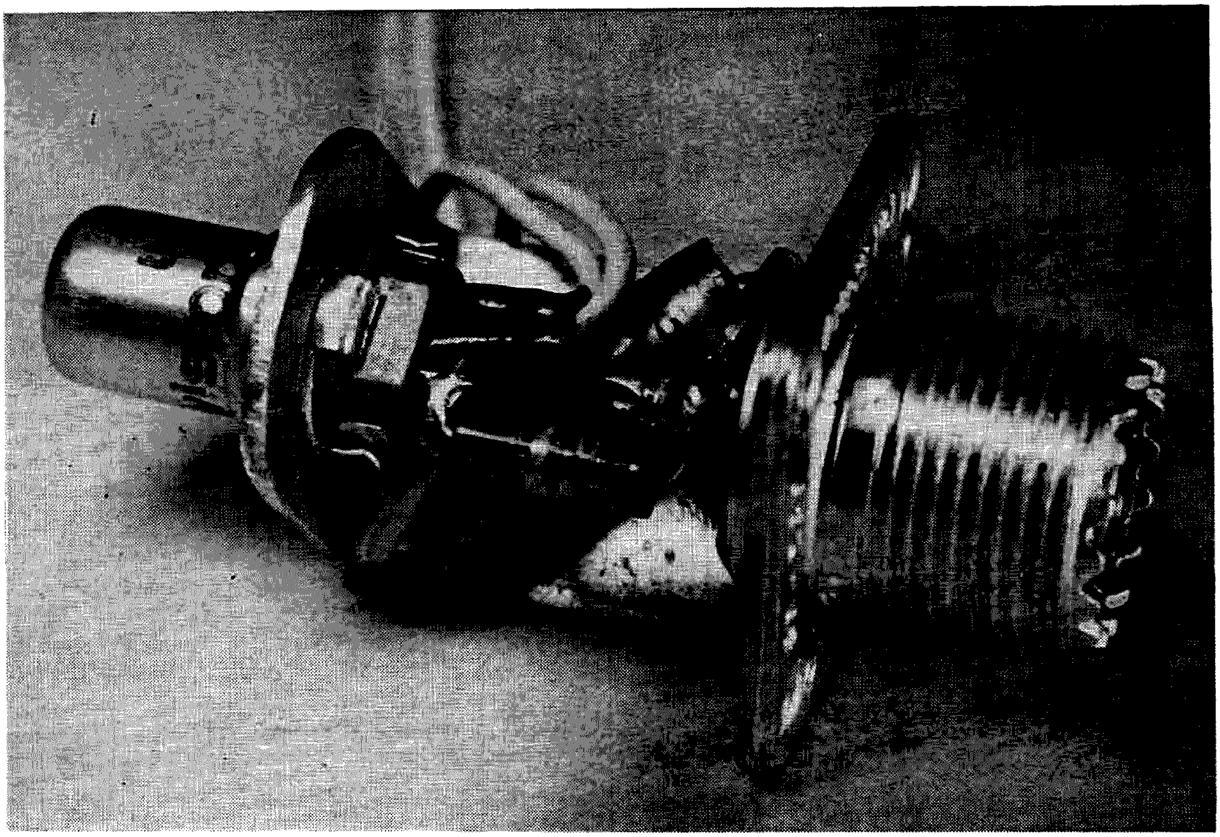
Unsolder, at the plate supply switch, the wire connecting one terminal of this switch to a ground lug. This wire should then be rolled up, taped, and kept inside the chassis. The two other wires connected to the switch should also be unsoldered, however they must remain connected. This connection—as with the previously disconnected wire—should be taped and tucked in some out-of-the-way position inside the chassis. In this manner it will be an easy operation to return the modulator back to its original condition, should you so desire. The schematic diagram of the newly added mode switch is shown in Fig. 1 and needs no explanation. In order to bring out the leads of this switch a "U" shaped hole was made on the very edge of the bottom plate which fastens to the chassis just large enough for the leads going to the switch.

Although I have not tried it, a 3PDT switch could also no doubt be used. The "third" set of contacts could then be used to control the ac power going to the modulator. In this way the modulator would automatically be in the AM mode when turned on, and in the CW position when turned off.

The arrangement shown in Fig. 1 has been in use for some time now at this station and has given me no trouble. It is indeed much easier to switch from 'phone to code with this switch than it is to reach behind the 720 and 730 and plug and unplug connectors every time you want to change mode. . . . WφDSU

2PDT SWITCH





A Simple, Nuvistor RF Pre-Amp

Joe Williams W6SFM
4150 Beck Avenue
North Hollywood, Calif.

THE NUVISTOR is scarcely larger than a transistor but will come close to the 417A in performance and at much less power drain. The transconductance-to-plate current ratio of the RCA 6CW4, 7586, 7587 and 6DS4 series makes them excellent rf amplifiers where high gain and low noise are sought.

Whether we hams like it or not, we are moving slowly but surely toward a sunspot nadir. This means that those of us with inexpensive receivers are beginning to notice that signals just don't have the wallop that they did back in those days when it was almost possible to work DXCC with a window screen antenna. One way to make things seem better is to amplify incoming signals before they reach the receiver. The manner and degree of pre-receiver signal processing is largely a matter of the individual operator's choice. A compact and effective cascode Nuvistor pre-selector has been devised and described by Fred Cupp, K8AOE.*

The single Nuvistor preamplifier detailed here was made to work with a 2 band quad but will perform as well with a folded dipole. It will be noted that the antenna forms the tuned input circuit for the 6CW4. (Fig. 1). The plate circuit for the tube is the antenna input coil of the receiver. Since most receivers have low impedance inputs, a match is obviously not obtained. This causes the input to be relatively unloaded and results in an increase of "Q" in the tuned circuit of the rf amplifier or the mixer. At the expense of some gain, this will improve the selectivity and reduce QRM- and QRN-type noises. The receiver is peaked with the antenna trimmer as usual and the net gain of the preamplifier is about

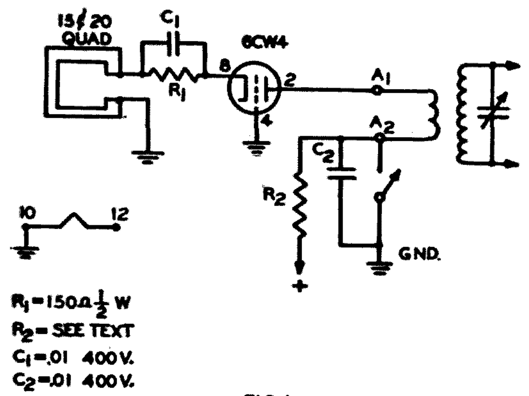


FIG. 1

12 db, or 2 "S" units. The grounded grid configuration of this preamp makes neutralization unnecessary and it should function well at 6 and 2 meters.

Construction

The amplifier proper was constructed so that it could be incorporated into the receiver by mounting the SO 239 coax fitting in lieu of the existing fitting on the set chassis. This requires one square inch of chassis surface and 1½ cubic inches of under-chassis space. From the photo it will be seen that the 'chassis' of the preamp consists of the SO 239 and a 1½ x ¾" scrap of brass. The brass was punched for the Nuvistor socket, bent and soldered to the coax chassis mount. It is intended that the square flange of the SO 239 be under the chassis or behind a panel when the amplifier is mounted on a receiver. Only the threaded barrel and the heads of the mounting bolts would be exposed. R 1, the cathode bias resistor, and C 1 its bypass, are contained within the small chassis as shown. R 2, the plate dropping resistor, and C 2, the link bypass capacitor, are located adjacent to their associated circuits in the receiver. If the amplifier is operated or tested without its being attached to the receiver, remember to connect a jumper between the two chassis to make a heater and plate return circuit.

R 2 is a 5 watt resistor and its value is determined by Ohm's Law. The tube will draw about 10 mils of plate current and 100 ohms will be required for each volt of plate supply in excess of the 75 volts needed for the 6CW4.

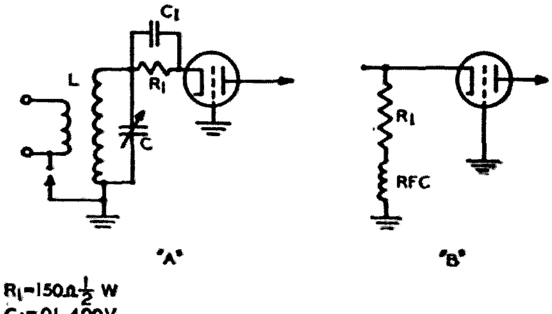


FIG. 2

The Hook Up

The antenna connection on most receivers consists of 3 screw type connectors marked A 1, A 2 and GND. Usually there is a swinging strap that connects GND and A 2 when an unbalanced antenna is used. When this type of preamp is fed into the receiver, the strap is disconnected from A 2 and the A 2 connection is bypassed to ground via a capacitor. (C 2). A 1 is connected to the Nuvistor plate. As is customary, the heater and plate supply for the amplifier is snaffled from the receiver. Pin 10 of the 6CW4 is grounded and pin 12 is connected to the nearest tube or tie point where 6.3 volts ac can be picked up. The plate is furnished B plus through R 2 which is connected between the A 2 antenna post and a convenient bus point.

If this preamplifier is used with an antenna that will not provide a dc cathode return, an alternate input circuit is required. (Fig. 2). The simplest way to use this device with an ac-dc receiver is to use a separate 6.3 volt filament transformer for the 6CW4.

. . . W6SFM

*All Band Nuvistor Pre-Selector, 73 Magazine for July 1962.

PARTS KIT AVAILABLE

As a service to those hams who are a little short in the spare parts department we have available for immediate delivery a kit of the parts used in this preamp. The regular net price on these parts runs close to $5.00 if ordered separately from a standard parts catalog. Quantity buying permits us to sell this kit for $4.00 postpaid in the U. S. Order Kit—W6SFM-1

Letter

Dear Wayne,

Your reader is correct in his Canadian info. The Canadian Ministry of Transport has issued last year a directive whereby "landed immigrants" where eligible for VE calls for at least five years, which is the required period to apply for Canadian citizenship. No previous holding of a license is required. The applicant is treated as a Canadian national.

Upon learning this, and considering that Canada has special privileges for issuance of visas to English and French applicants, due to Canadian history, I immediately petitioned the French Ministry for Telecommunications to extend reciprocity to Canadians in France. The Ministry agreed, but for those Canadians holding long

time residence papers. Through my job, I am familiar with French regulations on aliens in France, I knew that very few, if any, Canadians would meet the requirements. I protested with some documentary evidence and was later informed by the Ministry that, after consultation with other Departments, henceforth any Canadian will be eligible for an F license, irrespective of his resident status. This was reported to Mr. George Hees, Minister for Transport, in Ottawa, with whom I was in contact. A Canadian applied in Paris and was issued the call F8VE.

Considering the rather thorough screening of immigrants in the United States and their obligation to report their residence to the Department of Justice, a step in the direction of making resident aliens eligible for licenses could be considered. In view of what happened for Canadians in France, I am sure it would work equally well for Americans. During the last ten years I have received assurances from the Ministry itself that they have no objection of principle to license anyone, as long as it does not appear as a one side courtesy. Proof of this is the continuing licensing of Americans with F7 calls, without examination, tax or station inspection, for which nobody complains, except for occasional high power phone patching . . . hi.

Bernard Malandain F9MH/W2

But Bernard, until our Communications Act is modified by Congress to permit the FCC to take such measures, no alien, whether an immigrant with first Citizenship Papers, a resident representative of a friendly foreign nation, or a visiting ham can be licensed. This is an unfortunate result of a clause in the Act which was never intended to achieve this result. All of us are victims of this sloppy legislation which was originally supposed to protect U. S. commercial radio operators from lower wage imported help and was foisted on us by our labor unions. Now attempts to correct this carelessness are being fought by a few ignorant but loud isolationists and ultra-rightists, while the rest (for the most part) of us sit by and talk about something more interesting. Now and then some ham wakes up all of a sudden when he decides to try his hand at DXpeditioning and finds that a great deal of the world is pretty bitter about the non-reciprocity of the U. S.

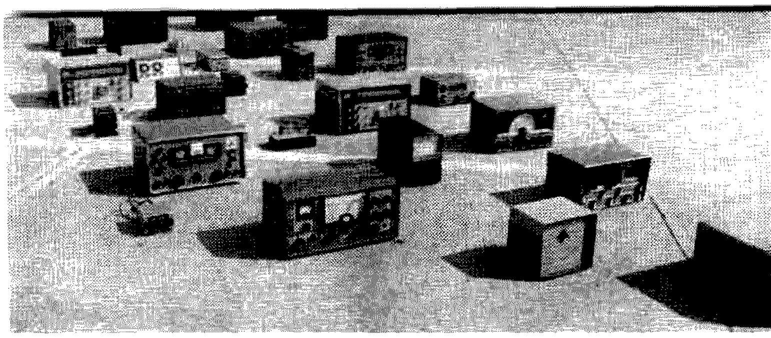
New Products

Miller Catalog

Homebrewers will do well to drop J. W. Miller a line asking for their 1963 catalog. Coils, transformers, chokes, forms, by the gross. 5917 S. Main, Los Angeles 3, California. 48 Pages.

Quaker Kits

Back in November (page 21) we ran a little review of the Quaker crystal grinding kit. The response was so good to this item that Quaker has had to expand their kit line and now has three different models, plus all sorts of additional materials. You should send for their price list and see for yourself. The biggest item now is a whopper kit containing 35 crystals in holders, 15 extra crystal blanks, ammonium bifluoride etch, grinding compound, plastic containers, spoons, and wooden crystal blank holders. $12.50. Write Quaker Electronics, Mountain Top, Pennsylvania.

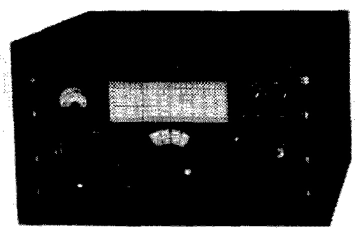


RECEIVER

BUYING GUIDE

We sure hope that you'll get a lot of use out of this guide. The brainstorm, if you like the idea, started with the editor hack one year ago. This was then transferred to Roy Pafenberg W4WKM who did the immense amount of research necessary. Most manufacturers cooperated on the project, but it took a couple of them almost a full year to blast loose with photos of their receivers and some of the other data. We want to thank Allied Radio Corporation of Chicago, Henry Radio Stores of Los Angeles, Evans Radio of Concord, and World Radio Laboratories of Council Bluffs for their cooperation in giving us the dealer prices on the used receivers. These prices will vary somewhat as a result of supply, demand and condition of a particular receiver, of course.

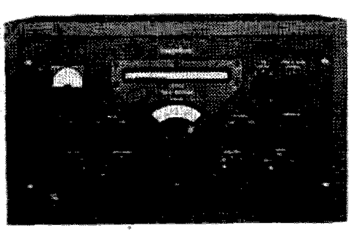
Collins 75A-1



1947-1950

Frequency Coverage: 80, 40, 20, 15, 11, and 10 meter amateur bands.
Specifications: 13 tubes plus rectifier; selectivity adjustable from .2 to 4 kc at 6 db down; sensitivity of 1 microvolt for 10 db S/N ratio.
Special Features: Dual conversion superhet with crystal controlled 1st oscillator and tunable 1st if; PTO oscillator-slug rack tuning of 1st if to provide direct reading calibration on all bands; variable selectivity crystal filter; noise limiter; S-Meter; amplified AVC; noise limiter and receive-standby switch.
Last Amateur Net Price: $375.00 including speaker.
Current Used Price: $240.00

Collins 75A-2



1950-1953
Frequency Coverage: 160, 80, 40, 20, 15, 11 and 10 meter amateur bands.
Specifications: 14 tubes plus rectifier; antenna input impedance of 50 to 150 ohms dependent on frequency, balanced or unbalanced input; selectivity of 2.4 kc at 6 db down and 10.5 kc at 60 db down in "broad" position; selectivity of .2 kc at 6 db down and 4.6 kc at 60 db down in "narrow" position.
Special Features: Dual conversion superhet with crystal controlled 1st oscillator and tunable 1st if; PTO oscillator-slug racl tuning of 1st if to provide direct reading calibration on all bands; variable selectivity crystal filter; noise limiter; antenna trimmer; S-Meter; amplified AVC; provisions for optional crystal calibrator and NBFM adaptor; front panel calibration corrector; receive-standby switch.
Last Amateur Net Price: $440.00
Current Used Price: $295.00

Collins 75A-4

1955-1959

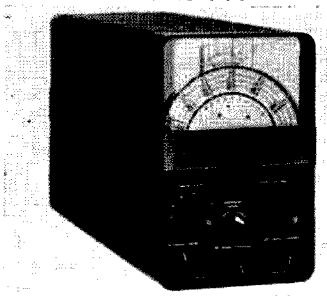
Frequency Coverage: 160, 80, 40, 20, 15, 11 and 10 meter amateur bands.
Specifications: 20 tubes plus regulator and rectifier; sensitivity of 1.0 microvolt for 10 db S/N ratio at 3 kc; selectivity of 3.1 kc with mechanical filter supplied, optional 0.5, 1.5, 2.1, 4.0, and 6.0 kc available; calibration accuracy of 0.3 kc; image rejection of greater than 50 db; audio output of .75 watts into external 4 or 500 ohm loads.
Special Features: Dual conversion superhet with crystal controlled 1st oscillator and tunable 1st if; PTO unit and slug rack tuning used to provide direct reading calibration on all bands; passband tuning; Q-Multiplier; product detector for CW-SSB reception; crystal calibrator with front panel corrector; selectable AGC time constant; separate AGC if stage and detector; noise limiter antenna trimmer and S-Meter.
Dimensions: 17 1/4" x 10 1/2" x 15 1/2" deep.
Weight: 35 pounds.
Last Amateur Net Price: $790.00
Current Used Price: $495.00 and up.

Collins 75S-1

1958-Still Marketed

Frequency Coverage: Any 14, 200 kc bands between 3.4 and 30.0 mc. 12 crystals supplied cover 80, 40, 20, 15 and 28.5 to 28.7 portion of the 10 meter band, plus 15 mc WWV.
Specifications: 12 tubes plus selenium diode and 2 silicon rectifiers; 50 ohm antenna input; 2955 to 3155 tunable if, 455 kc fixed if; SSB selectivity is 2.1 kc at 6 db down, CW selectivity is 0.5 kc at 6 db down and am selectivity is 4.5 kc at 6 db down, 25 kc at 60 db down; sensitivity is 1 microvolt for 15 db signal to noise ratio for SSB operation; 4 ohm speaker output plus 500 ohm VOX output; draws 90 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Dual conversion superhet with crystal controlled 1st oscillator and bandpass 1st if; PTO 2nd oscillator; SSB filter supplied and if transformer selectivity used for am reception; optional CW and am filters are available. Filters are miniature Collins mechanical filters; product detector for CW/SSB reception; selectable sideband reception using crystal controlled BFO; S-Meter; muting and control system for integration with 32S-1 transmitter.
Dimensions: 6 7/8 x 14 1/2" x 11 5/8" deep.
Weight: 25 pounds.
Last Amateur Net Price: $525.00.
Current Used Price: $380.00 and up.

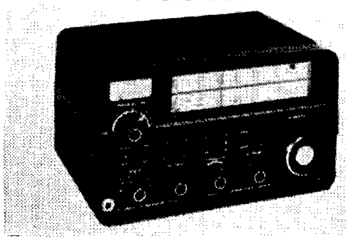
Drake 1-A



1957-1960

Frequency Coverage: (1) 3.5 to 4.1 mc. (2) 7.0 to 7.6 mc. (3) 14.0 to 14.6 mc. (4) 21.0 to 21.6 mc. (5) 28.0 to 28.6 mc. (6) 28.5 to 29.1 mc. (7) 29.1 to 29.7 mc. (8) WWV-10 mc.
Specifications: 12 tubes plus rectifier; 50-75 ohm antenna input; 2.9-3.5 mc tunable if, 50 and 1100 kc fixed if; sensitivity of less than 1 microvolt for 20 db S/N ratio; selectivity of 2.5 kc at 6 db down and 8.1 kc at 60 db down; draws 50 watts from 115 v, 60 cycle ac line.
Special Features: Internal PM speaker, triple conversion superhet with bandpass tuning, crystal controlled first oscillator, crystal calibrator, antenna attenuator, antenna trimmer, product detector for SSB, CW and AM reception, S-Meter, amplified AVC and muting terminals.
Dimensions: 6 3/4" x 11" x 15" deep.
Weight: 18 pounds.
Last Amateur Net Price: $299.95.
Current Used Price: $189.00.

Drake 2-A



1960-1961

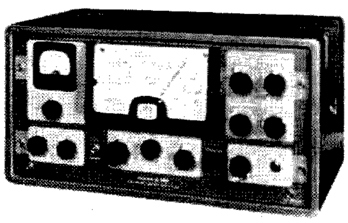
Frequency Coverage: Any 12, 600 kc bands between 3.5 and 30.0 mc with optional crystals. Crystals supplied for (1) 3.5 to 4.1 mc. (2) 6.9 to 7.5 mc. (3) 13.9 to 14.5 mc. (4) 20.9 to 21.5 mc. (5) 28.5 to 29.1 mc.
Specifications: 9 tubes plus rectifier and crystal diode; 50-75 ohm unbalanced antenna input; 3.5-4.1 mc tunable if, 50 and 455 kc fixed if; sensitivity of less than 0.5 microvolt for 10 db S/N ratio; selectivity of 2.4 kc at 6 db down and 8.5 kc at 60 db down or 4.8 kc at 6 db down and 23 kc at 60 db down; draws 40 watts from 120 v, 60 cycle ac line.
Special Features: Triple conversion superhet with adjustable bandwidth and bandpass tuning, crystal controlled first oscillator, optional crystal calibrator, selectable sideband product detector for SSB, CW and AM plus diode detector for CW and AM reception, S-Meter, amplified and delayed AVC, muting and VOX terminals.
Dimensions: 12" x 7" x 9" deep.
Weight: 14.5 pounds.
Last Amateur Net Price: $269.95.
Current Used Price: $210.00.

Drake 2-B

1961-Still Marketed

Frequency Coverage: Any 12, 600 kc bands between 3.5 and 30.0 mc with optional crystals. Crystals supplied for (1) 3.5 to 4.1 mc. (2) 6.9 to 7.5 mc. (3) 13.9 to 14.5 mc. (4) 20.9 to 21.5 mc. (5) 28.5 to 29.1 mc.
Specifications: 9 tubes plus rectifier; 50-75 ohm unbalanced antenna input; 3.5-4.1 mc tunable if, 50 and 455 kc fixed if; sensitivity of less than 0.5 microvolt for 10 db S/N ratio; selectivity of 0.5 kc at 6 db down and 2.75 kc at 60 db down, 2.1 kc at 6 db down and 7.5 kc at 60 db down or 3.6 kc at 6 db down and 10.5 kc at 60 db down; draws 40 watts from 120 v, 60 cycle ac line.
Special Features: Triple conversion superhet with adjustable bandwidth and bandpass tuning, crystal controlled first oscillator, optional crystal calibrator, selectable sideband product detector for SSB, CW and AM plus diode detector for CW and AM reception, S-Meter, noise limiter, amplified and delayed AVC with adjustable time constant, Q multiplier socket, muting and VOX terminals.
Accessories: Model 2-AQ Q-Multiplier and Deluxe Speaker. Model 2-AC Crystal Calibrator.
Dimensions: 12" x 7" x 9" deep.
Weight: 14.5 pounds.
Last Amateur Net Price: $279.95.
Current Used Price: 2-B Receiver $222.00

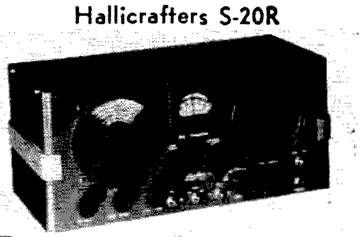
Geloso G-209-R



1959-Still Marketed

Frequency Coverage: Amateur bands, 80 through 10 meters plus 11 meter band.
Specifications: 12 tubes plus filament regulator, voltage regulator and semiconductor power supply; balanced or unbalanced antenna input; 467 and 4,600 kc if frequencies; 3.2 and 500 ohm audio output into external speaker; draws 90 watts from 110/125/140/160/220 v, 50/60 cycle ac line.
Special Features: Double conversion superhet; crystal filter; crystal controlled 2nd conversion oscillator with selectable sideband feature; separate product detector for CW/SSB reception; S-Meter; crystal calibrator; noise limiter; receive-standby switch.
Dimensions: 10" x 20" x 10 1/4" deep.
Last Amateur Net Price: $299.50
Current Used Price: $139.00

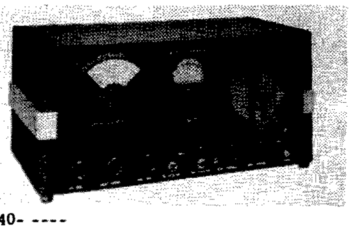
Hallicrafters S-20R



1939-1945

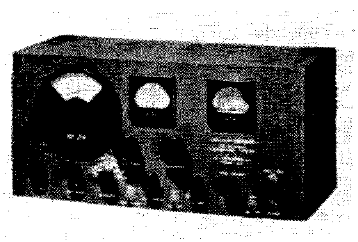
Frequency Coverage: .55 to 44.0 mc; (1) .55 to 1.78 mc. (2) 1.74 to 5.4 mc. (3) 5.3 to 15.8 mc. (4) 15,5 to 44.0 mc.
Specifications: 8 tubes plus rectifier; 400 ohms balanced or unbalanced antenna input; 455 kc if; draws 65 watts from 117v, 50/60 cycle ac line.
Special Features: Internal speaker, electrical vandspread, tone control, S-Meter receptacle, noise limiter and accessory receptacle.
Remarks: Available on surplus market following WW II.
Last Amateur Net Price: $60.00
Current Used Price: $25.00

Hallicrafters S-22R



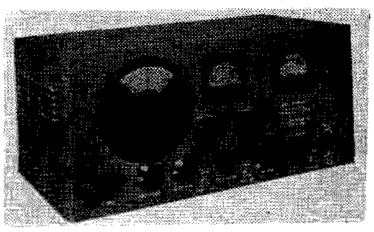
1940- ----
Frequency Coverage: 110 to 1500 kc and 1.7 to 18.0 mc; (1) 110 to 410 kc. (2) 400 to 1500 kc. (3) 1.7 to 5.9 mc. (4) 5.3 to 18.0 mc.
Specifications: 7 tubes plus rectifier; 400 ohms balanced or unbalanced antenna input; 1600 kc if; draws 50 watts from 110-125 v, 50/60 cycle ac line.
Special Features: Internal speaker, electriccal bandspread and tone control.
Dimensions: 18 1/2" x 8 1/2" x 9 1/4" deep.
Remarks: Available on surplus market following WW II.
Last Amateur Net Price: $74.50.
Current Used Price: $27.50.

Hallicrafters SX-24



1939- ----
Frequency Coverage: .54 to 43.5 mc; (1) .54 to 1.73 mc. (2) 1.7 to 5.1 mc. (3) 5.0 to 15.7 mc. (4) 15.2 to 43.5 mc.
Specifications: 8 tubes plus rectifier; 400 ohms balanced or unbalanced antenna input; 455 kc if; 500 and 5000 ohm audio output to external speaker; draws 70 watts from 100-125 v, 60 cycle ac line.
Special Features: Calibrated electrical bandspread, crystal filter, tone control, S-Meter, noise limiter and accessory socket.
Last Amateur Net Price: $74.00.
Current Used Price: $49.00.

Hallicrafters SX-25



1940-1945

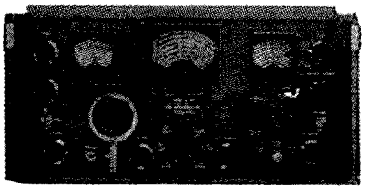
Frequency Coverage: .54 to 42.0 mc; (1) .54 to 1.7 mc. (2) 1.7 to 5.1 mc. (3) 5.0 to 15.7 mc. (4) 15.2 to 42.0 mc.
Specifications: 11 tubes plus rectifier; 400 ohm balanced or unbalanced antenna input; 455 kc if; 500 and 5000 ohm audio output to external speaker; draws 120 watts from 115 v, 60 cycle ac line.
Special Features: Calibrated electrical bandspread, crystal filter, tone control, S- Meter and noise limiter.
Remarks: Available on surplus market following WW II.
Last Amateur Net Price: $94.50.
Current Used Price: $55.00.

Hallicrafters S-27

1940-1942

Frequency Coverage: 27.5 to 145.0 mc; (1) 27.5 to 47.0 mc. (2) 46.0 to 82.0 mc. (3) 82.0 to 145.0 mc.
Power Consumption: Draws 115 watts from 115 v, 50/60 cycle ac line.
Remarks: See S-36 for further details. Available on surplus market following WW II.
Last Amateur Net Price: $195.00.
Current Used Price: $60.00.

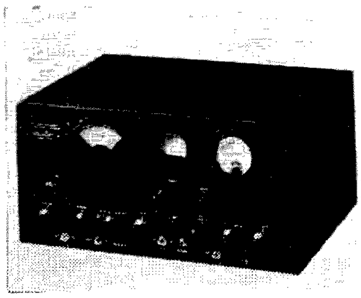
Hallicrafters SX-28 & A



1941-1944

Frequency Coverage: .55 to 43.0 mc; (1) .55 to 1.6 mc. (2) 1.6 to 3.0 mc. (3) 3.0 to 5.8 mc. (4) 5.8 to 11.0 mc. (5) 11.0 to 21.0 mc. (6) 21.0 to 43.0 mc.
Specifications: 14 tubes plus rectifier; 400 ohms balanced or unbalanced antenna input; 455 kc if; sensitivity of 6 to 20 microvolts over range of receiver for 500 mw audio output; selectivity of 12 kc at 2X down, 36 kc at 1000X down in broad position and 4.1 kc at 2X down, 22 kc at 1000X down in sharp position; audio power output of 8 watts into 500 or 5000 ohm load; draws 138 watts from 117 v, 60 cycle ac line.
Special Features: Calibrated electrical bandspread, crystal filter, phono input, tone control, S-Meter, noise limiter, antenna trimmer and external power supply receptacle.
Dimensions: 20 1/2" x 10" x 14 3/4" deep.
Weight: 75 pounds.
Remarks: SX-28A was government version using improved parts and layout. Both models were available on the surplus market following WW II.
Last Amateur Net Price:
SX-28.......$179.50.
SX-28A..... $223.00.
Current Used Price:
SX-28.......$75.00.
SX-28A..... $85.00.

Hallicrafters S-36



1942-1944

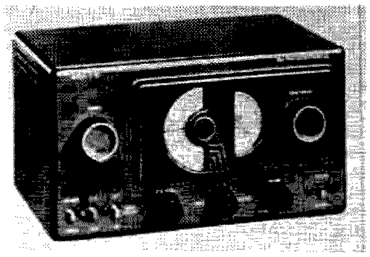
Frequency Coverage: 27.8 to 143 mc; (1) 27.8 to 47.0 mc. (2) 46.0 to 82.0 mc. (3) 82.0 to 143.0 mc.
Specifications: 13 tubes plus voltage regulator and rectifier; balanced or unbalanced antenna input; 5.25 mc if; sensitivity of 2 microvolts at 30 mc and 10 microvolts at 135 mc for 50 mw audio output; selectivity of not less than 10 kc or more than 25 kc in sharp position and not less than 65 kc,or more than 80 kc in broad position at 6 db down; audio output of 3 watts into 500 or 5000 ohm load; draws 115 watts from 115 or 230 v, 50/60 cycle ac line.
Special Features: AM and FM reception, adjustable selectivity, tone control, S-Meter, noise limiter, antenna trimmer and external power receptacle.
Remarks: Available on the surplus market following WW II.
Last Amateur Net Price: $307.50.
Current Used Price: $49.00.

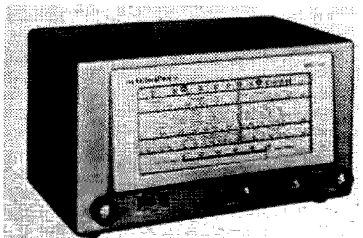
Hallicrafters S-37

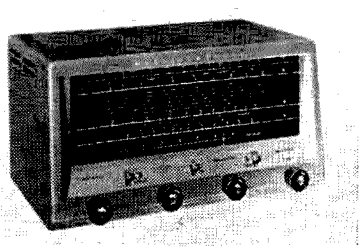
1942- ----

Frequency Coverage: 130.0 to 210.0 mc in one band.
Specifications: 12 tubes plus voltage regulator and rectifier; balanced or unbalanced antenna input; 16 mc if; 500 and 5000 ohm audio output; operated from internal ac power supply or external batteries.
Special Features: AM and FM reception, tone control, S-Meter, noise limiter, antenna trimmer and external power receptacle.
Remarks: Available on the surplus market following WW II.
Last Amateur Net Price: $591.75.
Current Used Price: $40.00.

Hallicrafters S-38 thru EM



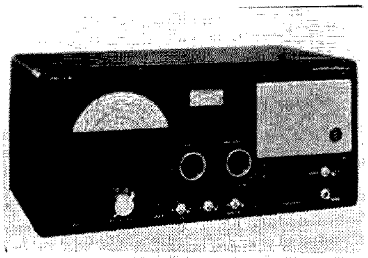




1946-1959

Frequency Coverage: .55 to 31.0 mc; (1) .55 to 1.6 mc. (2) 1.6 to 5.0 mc. (3) 5.0 to 14.0 mc. (4) 13.0 to 31.0 mc.
Specifications: 4 or 5 tubes plus rectifier dependent on model; 52-600 ohm balanced or unbalanced antenna input; 455 kc if; draws 30 watts from 105-125 v dc or 50/60 cycle ac line.
Special Features: Internal speaker, electrical bandspread and, in some models, noise limiter.
Dimensions (Typical): 12 7/8" x 7" x 9" deep.
Weight (Typical): 12 pounds.
Remarks: Replaced S-19R Skybuddy. Data given is typical for the various models manufactured.
Last Amateur Net Price: $59.95.
Current Used Price: $32.50.

Hallicrafters S-40 thru BU



1946-1955

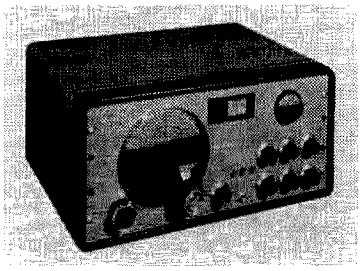
Frequency Coverage: .54 to 43.0 mc; (1) .54 to 1.7 mc. (2) 1.7 to 5.35 mc. (3) 5.35 to 15.7 mc. (4) 15.17 to 43.0 mc.
Specifications: 7 or 8 tubes plus rectifier dependent on model; 50-600 ohm balanced or unbalanced antenna input; 455 kc if; sensitivity of 15 microvolts at 550 kc and 8 microvolts at 40 mc for 500 mw audio output; selectivity of 6.8 kc at 6 db down and 40.7 kc at 60 db down; S-40, S-40A and S-40B draw 75 watts from 105-125 v, 50/60 cycle ac line; s-40AU and S-40BU draw 75 watts from 105-250 v, 25/60 cycle ac line.
Special Features: Internal 5" PM speaker, electrical bandspread, tone control, noise limiter and receptacle for external S-Meter.
Accessories: SM 40 S-Meter.
Remarks: Replaced S-20 Sky Champion. Data given is typical for the various models manufactured.
Last Amateur Net Price: $99.95.
Current Used Price: $60.00.

Hallicrafters S-41

946

Frequency Coverage: .55 to 30.0 mc in 3 bands.
Specifications: 5 tubes plus rectifier; 300 ohm balanced or unbalanced antenna input; 455 kc if; requires 105-125 v, 50/60 cycle ac power.
Special Features: Internal speaker, electrical bandspread and noise limiter.
Last Amateur Net Price: $36.75.
Current Used Price: $20.00.

Hallicrafters SX-42

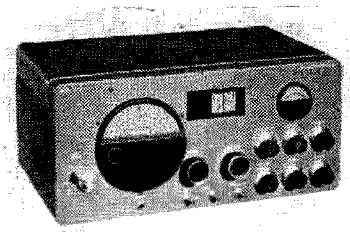


1946-1949

Frequency Coverage: .54 to 110.0 mc; (1) .54 to 1.62 mc AM/CW. (2) 1.62 to 5.0 mc AM/CW. (3) 5.0 to 15.0 mc AM/CW. (4) 15.0 to 30.0 mc AM/CW. (5) 27.0 to 55.0 mc AM/CW/FM. (6) 55.0 to 110.0 mc AM/CW/FM.
Specifications: 13 tubes plus voltage regulator and rectifier; 300 ohm balanced or unbalanced antenna input; 455 kc AM if and 10.7 mc FM if; 500 or 5000 ohm audio output; draws 110 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Calibrated electrical bandspread, adjustable selectivity, crystal filter, FM/AM reception, tone control, S-

Meter, noise limiter and external power supply receptacle.
Remarks: Replaced SX-28. Standard rack mounting, cabinet supplied.
Last Amateur Net Price: $275.00.
Current Used Price: $140.00.

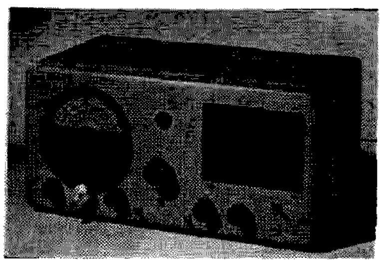
Hallicrafters SX-43



1947

Frequency Coverage: .54 to 55.0 mc and 86.0 to 109.0 mc; (1) .54 to 1.7 mc AM/CW. (2) 1.7 to 5.0 mc AM/CW. (3) 5.0 to 16.0 mc AM/CW. (4) 15.5 to 44.0 mc AM/CW. (5) 44.0 to 55.0 mc AM/CW/FM. (6) 86.0 to 109.0 mc AM/CW/FM.
Specifications: 10 tubes plus rectifier; 72-600 ohm balanced or unbalanced antenna input; 455 kc AM if and 10.7 mc FM if; 500 or 5000 ohm audio output; draws 90 watts from 105-125v, 50/60 cycle ac line.
Special Features: Calibrated electrical bandspread, adjustable selectivity, crystal filter, FM/AM reception, tone control, S-Meter, phono input, noise limiter and external power supply receptacle.
Last Amateur Net Price: $169.50.
Current Used Price: $100.00.

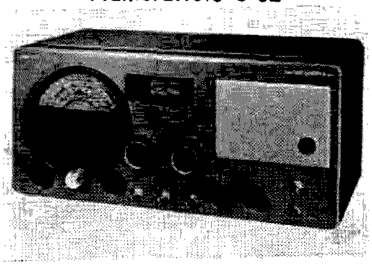
Hallicrafters S-51



1947

Frequency Coverage: 132 to 405 kc and .485 to 13 mc; (1) 132 to 405 kc. (2) .485 to 1.53 mc. (3) 1.45 to 4.55 mc. (4) 4.2 to 13.0 mc.
Specifications: 9 tubes plus rectifier; 300 ohm balanced or unbalanced antenna input; 455 kc if; draws 30 watts from 105-125 v, 50/60 cycle ac or dc line.
Special Features: Internal 5" PM speaker; 1 fixed tune channel in 200 to 300 kc range and 2 fixed tune channels in 2.0 to 3.0 mc range, tone control, noise limiter and provisions for internal vibrator power supplies.
Accessories: 6, 12 and 32 volt vibrator power supplies.
Last Amateur Net Price: $200.00.
Current Used Price: $90.00.

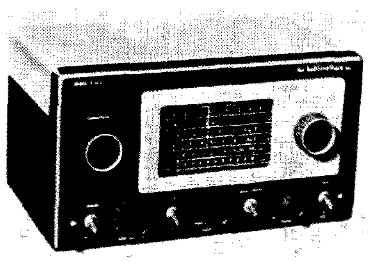
Hallicrafters S-52



1948

Frequency Coverage: .54 to 44.0 mc; (1) .54 to 1.68 mc. (2) 1.68 to 5.4 mc. (3) 5.3 to 15.5 to 44.0 mc.
Specifications: 7 tubes plus rectifier; 50-600 ohm balanced or unbalanced antenna input; 455 kc if; draws 40 watts from 105-125 v, 50/60 cycle ac or dc line; provisions for operation from 220 v line with optional ballast resistor.
Special Features: Internal 5" PM speaker, electrical bandspread, tone control and noise limiter.
Last Amateur Net Price: $99.50.
Current Used Price: $40.00.

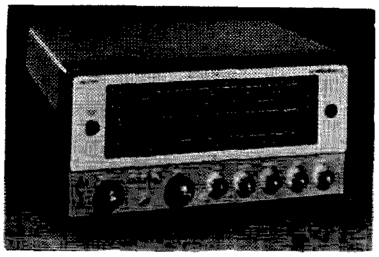
Hallicrafters S-53, A & U



S-53: 1948-1950. S-53A: 1950-1958. S-53U: 1948-1955.

Frequency Coverage: .55 to 1.65 mc, 2.6 to 31.0 mc and 48.0 to 55.0 mc; (1) .55 to 1.65mc. (2) 2.6 to 6.4 mc. (3) 6.2 to 16.5 mc. (4) 14.0 to 31.0 mc. (5) 48.0 to 55.0 mc.
Specifications: 7 tubes plus rectifier; 50-600 ohm balanced or unbalanced antenna input; 2.075 mc if; S-53 and S-53A draw 50 watts from 105-125 v, 50/60 cycle ac line; S-53U draws 50 watts from 105-250 v, 40 to 130 cycle ac line.
Special Features: Internal 5" PM speaker, electrical bandspread, tone control and noise limiter.
Last Amateur Net Price:
S-53............$79.50.
S-53A.......... $89.95.
S-53U.......... $88.50.
Current Used Price: S-53.......$50.00.
S-53A..... $55.00.

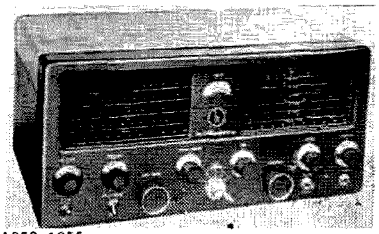
Hallicrafters SX-62, A & U



SX-62: 1945-1948. SX-62A: 1955 -Still Marketed.

Frequency Coverage: .54 to 109 mc; (1) .54 to 1.62 mc AM/CW. (2) 1.62 to 4.9 mc AM/CW. (3) 4.9 to 15.0 mc AM/CW. (4) 15.0 to 32.0 mc AM/CW. (5) 27.0 to 56.0 mc AM/CW/FM. (6) 54.0 to 109.0 mc AM/CW/FM.
Specifications: 14 tubes plus voltage regulator and rectifier; 50-600 ohm balanced or unbalanced antenna input; 455 kc if from .54 to 32.0 mc and 10.7 mc if from 27.0 to 109.0 mc; 3.2, 8 or 500 ohm audio output; SX-62 and SX-62A draw 120 watts from 105-125 v, 50/60 cycle ac line; SX-62U draws 120 watts from 105-250 v, 25 to 100 cycle ac line.
Special Features: Crystal Filter, adjustable selectivity, FM/AM reception, tone control, "hi-fi" audio system with phono input, noise limiter, crystal calibrator with dial adjustment and provisions for external battery or vibrator power supply.
Dimensions: 20" x 10 1/2" x 16" deep.
Weight: 67 pounds.
Last Amateur Net Price:
SX-62..............$269.50.
SX-62A........... $395.00.
SX-62U............ $282.00.
Current Used Price:
SX-62..........$190.00.
SX-62A........ $210.00 and up.

Hallicrafters SX-71 & U



1950-1955

Frequency Coverage: .56 to 34.0 and 46.0 to 56.0 mc; (1) .56 to 1.6 mc. (2) 1.65 to 4.7 mc. (3) 4.7 to 13.4 mc. (4) 12.8 to 34.0 mc. (5) 46.0 to 56.0 mc.
Specifications: 11 tubes plus voltage regulator and rectifier; 50-600 ohm balanced or unbalanced antenna input; 455 kc and 2.075 mc if; 3.2 or 500 ohm audio output; SX-71 draws 90 watts from 105-125 v, 50/60 cycle ac line; SX-71U draws 90 watts from 105-250 v, 25 to 130 cycle ac line.
Special Features: Calibrated electrical bandspread, double conversion if system, crystal filter, AM, CW and NBFM detectors, phono input, noise limiter, tone control and accessory/external power supply socket.
Last Amateur Net Price: $199.50.
Current Used Price: $125.00.

Hallicrafters S-72 & L

1949-1955

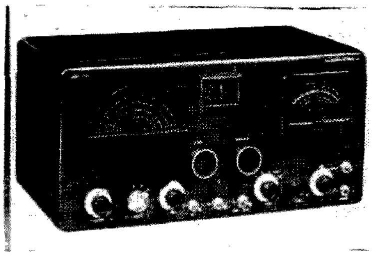
Frequency Coverage: S-72: .55 to 30.0 mc; (1) .55 to 1.6 mc. (2) 1.5 to 4.4 mc. (3) 4.5 to 11.5 mc. (4) 11.0 to 30.0 mc. S-72L: 180 to 400 kc and .55 to 11.5 mc; (1) 180 to 400 kc. (2) .55 to 1.6 mc. (3) 1.6 to 4.4 mc. (4) 4.5 to 11.0 mc.
Specifications: 8 tubes plus dry rectifier; self-contained loop antenna for band 1 of S-72 and bands 1 and 2 of S-72L, internal whip or external long wire antenna for other bands; 455 kc if; draws 25 watts from 105-125 v, 50/60 cycle ac or dc line or operates from self-contained dry batteries.
Special Features: Internal 5" PM speaker, electrical bandspread, noise limiter and portable case.
Last Amateur Net Price: $79.95.
Current Used Price: $44.00.

Hallicrafters SX-73

1952

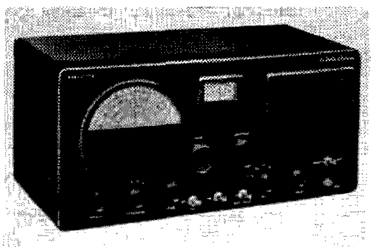
Frequency Coverage: .54 to 54.0 mc; (1) .54 to 1.27 mc. (2) 1.27 to 3.0 mc. (3) 3.0 to 7.0 mc. (4) 7.0 to 13.8 mc. (5) 13.8 to 29.7 mc. (6) 29.7 to 54.0 mc.
Specifications: 17 tubes plus voltage regulator and rectifier; 50-200 ohm balanced or unbalanced antenna input; 455 kc and 6.0 mc if; sensitivity of less than 2 microvolts for 10 db S/N ratio; selectivity adjustable from 14.0 kc at 6 db down and 34.0 kc at 60 db down to .4 kc at 6 db down and 6.0 kc at 60 db down; 2 watts audio output into 500 ohm load for 2 microvolt rf input; draws 120 watts from 95/105/117/130/190/210/234/260 volt, 50/60 cycle ac line.
Special Features: Provision for 6 crystal controlled channels, provision for external BFO, if amplifier output jack, crystal filter, adjustable selectivity, dual conversion if system, noise limiter, antenna trimmer, S-Meter and audio amplifier input jack.
Dimensions: 19" x 10 15/32" x 18 1/2" deep.
Weight: 58 pounds.
Remarks: Military type R-274/FRR.
Last Amateur Net Price: $975.00.
Current Used Price: $400.00.

Hallicrafters S-76 & U



1950-1955
Frequency Coverage: .538 to 1.58 and 1.72 to 34.0 mc in 4 bands.
Specifications: 9 tubes plus voltage regulator and rectifier; 300 ohm balanced or unbalanced antenna input; 50 and 1650 kc if; 3.2 or 500 ohm audio output; S-76 draws 77 watts from 105-125 v, 50/60 cycle ac line; S-76U draws 77 watts from 115-250 v, 25 to 60 cycle ac line.
Special Features: Calibrated electrical bandspread, dual conversion if system, adjustable selectivity, S-Meter, tone control, noise limiter, phono jack and external power/accessory socket.
Dimensions: 18 1/2"x 8 7/8" x 9 1/2" deep.
Last Amateur Net Price: $149.95.
Current Used Price: $99.00.

Hallicrafters S-77 & A



1950-1955

Frequency Coverage: .54 to 44.0 mc; (1) .54 to 1.68 mc. (2) 1.68 to 5.4 mc. (3) 5.3 to 15.5 mc. (4) 15.5 to 44.0 mc.
Specifications: 7 tubes plus rectifier; 50-600 ohm balanced or unbalanced antenna input; 455 kc if; draws 40 watts from 105-125 v, 50/60 cycle ac or dc line.
Special Features: Internal speaker, electrical bandspread, noise limiter and tone control.
Accessories: Ballast tube for 210-250 v power line.
Last Amateur Net Price: $89.95.
Currest Used Price: $55.00.

Hallicrafters S-85 & U

1955-1959

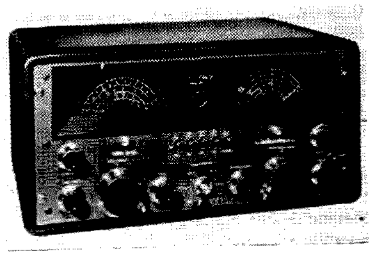
Frequency Coverage: .538 to 34.0 mc; (1) .538 to 1.6 mc. (2) 1.55 to 4.6 mc. (3) 4.6 to 13.0 mc. (4) 12.0 to 34.0 mc.
Specifications: 7 tubes plus rectifier; 52-600 ohm balanced or unbalanced antenna input; 455 kc if; S-85 draws 75 watts from 105-125 v, 50/60 cycle ac line; s-85U draws 75 watts from 100-250 v, 25 to 60 cycle ac line.
Special Features: Calibrated electrical bandspread, Internal 5" PM speaker, noise limiter and tone control.
Dimensions: 18 1/2" x 9" x 10 5/8" deep.
Weight: 27 1/2 pounds.
Remarks: Replaeed S-40B.
Last Amateur Net Price: $119.95.
Current Used Price: $82.00..

Hallicrafters S-86

1955-1959

Frequency Coverage: .538 to 34.0 mc; (1) .538 to 1.6 mc. (2) 1.55 to 4.6 mc. (3) 4.6 to 13.0 mc. (4) 12.0 to 34.0 mc.
Specifications: 7 tubes plus rectifier; 52-600 ohm balanced or unbalanced antenna input; 455 kc if; draws 40 watts from 105-125 v, 50/60 cycle ac or dc line.
Special Features: Internal 5" PM speaker, calibrated electrical bandspread, tone control and noise limiter.
Dimensions: 18 1/2" x 9" x 10 5/8" deep.
Remarks: Replaced S-77A.
Last Amateur Net Price: $119.95.
Current Used Price: $78.00.

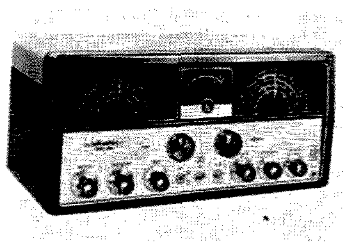
Hallicrafters SX-88 & U



1954-1955

Frequency Coverage: .535 to 33.0 mc; (1) .535 to 1.7 mc. (2) 1.69 to 3.0 mc. (3) 2.98 to 5.5 mc. (4) 5.4 to 10.0 mc. (5) 9.8 to 18.3 mc. (6) 17.8 to 33.0 mc.
Specifications: 17 tubes plus current regulator, voltage regulator and rectifier; 50-600 ohm balanced or unbalanced antenna input; 50 and 1550 kc if on band 2, 50 and 2075 kc if on all other bands; sensitivity of 1.0 to 1.5 microvolts for .5 watts audio output and 1.5 to 2.0 microvolts for 10 db S/N ratio on all except broadcast band; selectivity adjustable between .25 and 10 kc at 6 db down and 1.0 to 24.0 kc at 60 db down; 10 watts audio output into 3.2, 8 or 500 ohm load; SX-88 draws 138 watts from 105-125 v, 50/60 cycle ac line; SX-88U draws 138 watts from 100-250 v, 25 to 60 cycle ac line.
Special Features: Calibrated electrical bandspread, dual conversion if system, adjustable selectivity, crystal calibrator, antenna trimmer, amplified and delayed AVC, phono input jack, IF output jack, tone control, S-Meter, noise limiter and accessory/external power socket.
Dimensions: 19" x 8 3/4" rack panel, cabinet supplied.
Last Amateur Net Price: $595.00.
Current Used Price: $310.00.

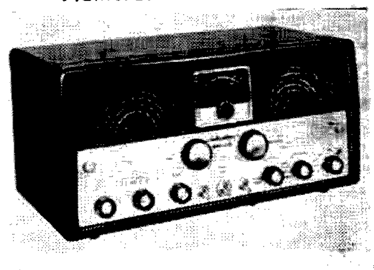
Hallicrafters S-96



1955-1956

Frequency Coverage: .538 to 1.58 mc and 1.72 to 34.0 mc; (1) .538 to 1.58 mc. (2) 1.72 to 4.9 mc. (3) 4.6 to 13.0 mc. (4) 12.0 to 34.0 mc.
Specifications: 10 tubes plus voltage regulator and rectifier; 300 ohm balanced or unbalanced antenna input; 50.5 and 1650 if; selectivity adjustable between .5 and 5.0 kc at 6 db down and 5.0 and 20.0 kc at 60 db down; 3.2 or 500 ohm audio output; draws 80 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Calibrated electrical bandspread, dual conversion if system with selectable sideband, phono input jack, S-Meter, noise limiter, tone control and accessory/external power socket.
Dimensions: 18 1/2" x 8 7/8" x 11" deep.
Weight: 34 1/2 pounds.
Last Amateur Net Price: $249.95.
Current Used Price: $169.00.

Hallicrafters SX-99 & U



1955-1959

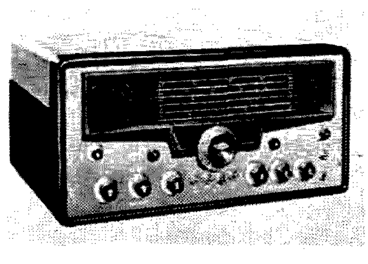
Frequency Coverage: .538 to 34.0 mc; (1) .538 to 1.6 mc. (2) 1.55 to 4.6 mc. (3) 4.6 to 13.0 mc. (4) 12.0 to 34.0 mc.
Specifications: 7 tubes plus rectifier; 52-600 ohm antenna input; 455 kc if; 3.2 or 500 ohm audio output; SX-99 draws 75 watts from 105-125 v, 50/60 cycle ac line; SX-99U draws 75 watts from 100-250 v, 25 to 60 cycle ac line.
Special Features: Calibrated electrical bandspread, antenna trimmer, crystal filter, S-Meter, noise limiter and tone control.
Dimensions: 18 3/4" x 9" x 10 3/4" deep.
Weight: 28 1/4 pounds.
Last Amateur Net Price: $149.95.
Current Used Price: $109.00.

Hallicrafters SX-100

1956-Still Marketed

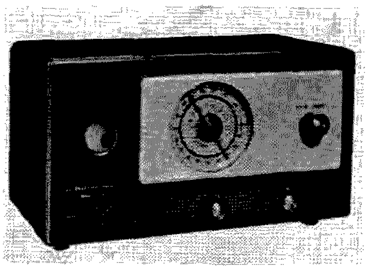
Frequency Coverage: .538 to 34.0 mc; (1) .538 to 1.58 mc. (2) 1.72 to 4.9 mc. (3) 4.6 to 13.0 mc. (4) 12.0 to 34.0 mc.
Specifications: 12 tubes plus voltage regulator and rectifier; 300 ohms balanced or unbalanced antenna input; 50.5 and 1650 kc if; adjustable selectivity of from 0.5 to 5.0 kc at 6 db down and from 5.0 to 20.0 kc at 60 db down; 3.2 or 500 ohm audio output; draws 88 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Calibrated electrical bandspread, dual conversion if system with selectable sideband, adjustable selectivity, antenna trimmer, notch filter, crystal calibrator, SSB AVC time constant, S-Meter, phono input jack, noise limiter and accessory/external power supply jack.
Dimensions: 18 1/2" x 8 7/8" x 11" deep.
Weight: 34 1/2 pounds.
Last Amateur Net Price: $325.00.
Current Used Price: $200.00.

Hallicrafters SX-101 & A



SX-101: 1957-1958. Sx-101A: 1959-Still Marketed.
Frequency Coverage: (1) 3.5 to 4.0 mc. (2) 7.0 to 7.3 mc. (3) 14.0 to 14.4 mc. (4) 21.0 to 21.5 mc. (5) 28.0 to 30.0 mc. (6) 10.0 mc WWV. (7) 2 & 6M converter input, 30.5 to 34.5 mc.
Specifications: 13 tubes plus voltage regulator and rectifier; 50-70 ohm balanced or unbalanced antenna input: 50.75 and 1650 kc if; sensitivity of 1 microvolt for 10 db S/N ratio except for converter band which is 4 microvolts; selectivity of .5, 1, 2, 3 and 5 kc at 6 db down; 3.2 or 500 ohm audio output; draws 115 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Dual conversion if system with selectable sideband, product detector for CW/SSB reception, notch filter, crystal calibrator, adjustable AVC time constant, tone control, S-Meter, antenna trimmer, noise limiter, internal heating element and accessory socket.
Dimensions: 20" x 10 1/2" x 16" deep.
Weight: 70 pounds.
Remarks: SX-101 had 160M coverage with no VHF converter input.
Last Amateur Net Price: SX-101.....$395.
SX-101A... $445.
Current Used Price: SX-101.....$239.
SX-101A.........279.00 and up.

Hallicrafters S-102



1956-1957

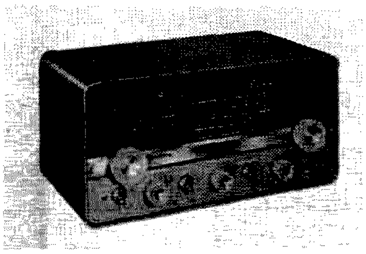
Frequency Coverage: 143 to 149 mc.
Specifications: 7 tubes plus selenium rectifier; 300 ohm balanced or unbalanced antenna input; 10.7 mc if; draws 40 watts from 105-125 v, 50/60 cycle ac or dc line.
Special Features: Internal 5" PM speaker, standby switch with external contacts and noise limiter.
Dimensions: 13" x 7 1/2" x 8 3/4" deep.
Weight: 13 pounds.
Last Amateur Net Price: $59.95.
Current Used Price: $37.50.

Hallicrafters S-106

1956-1957

Frequency: 50.0 to 54.0 mc.
Specifications: 7 tubes plus selenium rectifier; 300 ohm balanced or unbalanced antenna input; 10.7 mc if; draws 40 watts from 105-125 v, 50/60 cycle ac or dc line.
Special Features: Internal 5" PM speaker, standby switch with external contacts and noise limiter.
Dimensions: 13" x 7 1/2" x 8 3/4" deep.
Weight: 10 5/8 pounds.
Last Amateur Net Price: $59.95.
Current Used Price: $35.00.

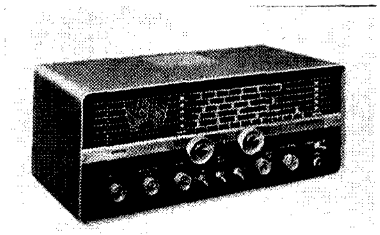
Hallicrafters S-107



1958

Frequency Coverage: .54 to 1.63, 2.51 to 31.0 and 48.0 to 54.0 mc; (1) .54 to 1.63 mc. (2) 2.5 to 6.3 mc. (3) 6.3 to 16.0 mc. (4) 14.0 to 31.0 mc. (5) 48.0 to 54.5 mc.
Specifications: 7 tubes plus rectifier; 52-600 ohm balanced or unbalanced antenna input; 455 kc if; draws 50 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Internal 4" x 6" speaker, electrical bandspread, noise limiter and external audio amplifier jack.
Remarks: Replaced S-53.
Last Amateur Net Price: $94.95.
Current Used Price: $72.00.

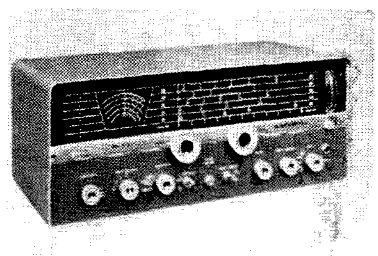
Hallicrafters S-108



1959-Still Marketed.

Frequency Coverage: .538 to 34.0 mc; (1) .538 to 1.6 mc. (2) 1.55 to 4.6 mc. (3) 4.6 to 13.0 mc. 12.0 to 34.0 mc.
Specifications: 7 tubes plus rectifier; 52-600 ohm balanced or unbalanced antenna input; 455 kc if; draws 75 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Internal 5" PM speaker, calibrated electrical bandspread, noise limiter and tone control.
Dimensions: 18 3/4" x 8" x 10 1/4" deep.
Weight: 28 1/4 pounds.
Last Amateur Net Price: $139.95.
Current Used Price: $109.00.

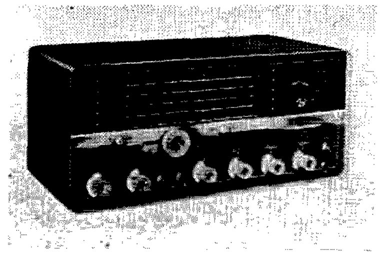
Hallicrafters SX-110



1959-Still Marketed.

Frequency Coverage: .538 to 34.0 mc; (1) .538 to 1.6 mc. (2) 1.55 to 4.6 mc. (3) 4.6 to 13.0 mc. (4) 12.0 to 34.0 mc.
Specifications: 7 tubes plus rectifier; 52-600 ohm balanced or unbalanced antenna input; 455 kc if; 3.2 or 500 ohm audio output; draws 75 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Calibrated electrical bandspread, crystal filter, S-Meter, tone control, noise limiter and antenna trimmer.
Dimensions: 18 3/4" x 8" x 10 1/4" deep.
Weight: 28 1/4 pounds.
Remarks: refined version of S-108, less speaker.
Last Amateur Net Price: $169.95.
Current Used Price: $125.00.

Hallicrafters SX-111



1959-Still Marketed.
Frequency Coverage: (1) 3.5 to 4.0 mc. (2) 7.0 to 7.3 mc. (3) 14.0 to 14.4 mc. (4) 21.0 to 21.5 mc. (5) 28.0 to 29.7 mc. (6) 10.0 mc WWV.
Specifications: 12 tubes plus voltage regulator and rectifier; 50-70 ohms unbalanced antenna input; 50.75 and 1650 kc if; sensitivity of less than 1.0 microvolt for 10 db S/N ratio; adjustable selectivity of from 0.5 to 5.0 kc at 6 db down; 3.2 or 500 ohm audio output; draws 83 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Dual conversion if system with selectable sideband, product detector for CW/SSB reception, notch filter, calibration oscillator, antenna trimmer, voltage regulated oscillator supply, S-Meter, noise limiter and receiving muting terminals.
Dimensions: 18 11/16" x 8 13/16" x 10 3/16" deep.
Weight: 35 3/4 pounds.
Last Amateur Net Price: $279.50.
Current Used Price: $200.00.

Hallicrafters SX-115

1961-Still Marketed.

Frequency Coverage: (1) 3.5 to 4.0 mc. (2) 7.0 to 7.5 mc. (3) 9.6 to 10.1 mc, uncalibrated. (4) 14.0 to 14.5 mc. (5) 21.0 to 21.5 mc. (6) 28.0 to 28.5 mc. (7) 28.5 to 29.0 mc. (8) 29.5 to 30.0 mc.
Specifications: 17 tubes plus voltage regulator and 5 silicon diodes; 50-70 ohm unbalanced antenna input; 50.75 and 1005 kc fixed and 6.505 to 6.005 mc variable if; sensitivity on AM of 1.0 microvolt for 10 db S/N ratio; sensitivity on SSB/CW of less than 0.5 microvolt; selectivity variable in 5 steps from .5 to 5 kc at 6 db down; audio output of 1.5 watts into 3.2 or 500 ohm load; draws 85 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Triple conversion if system with selectable sideband, product detector for CW/SSB reception, crystal controlled 1st and 3rd conversion oscillators, crystal calibrator, if-type noise limiter for CW/SSB and series type noise limiter for AM reception, amplified dual loop AVC with fast attack and slow release time constant, internal heating element, band gain equalization, inverse feedback audio system, antenna trimmer, S-Meter and accessory socket.
Dimensions: 16" x 10 1/2" x 16" deep.
Weight: 44 pounds.
Last Amateur Net Price: $595.00.
Current Used Price: $480.00.

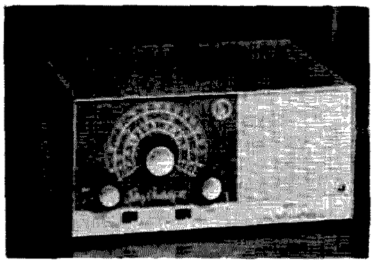
Hallicrafters S-118

1961-Still Marketed.

Frequency Coverage: 185 to 420 kc and .495 to 31.0 mc; (1) 185 to 420 kc. (2) .490 to 1.62 mc. (3) 1.6 to 4.95 mc. (4) 4.85 to 15.0 mc. (5) 14.8 to 31.0 mc.

Specifications: 5 tubes plus 2 silicon rectifiers; loopstick plus external antenna on bands 1 and 2; 50-75 ohm balanced or unbalanced antenna input for all other bands; 455 kc if; operates from 115 v, 50/60 cycle ac line.
Special Features: Internal speaker, electrical bandspread, phono input and audio output jacks, noise limiter and accessory/external power supply socket.
Dimensions: 14 1/2" x 5 11/16" x 8 1/2" deep.
Shipping Weight: 19 pounds.
Last Amateur Net Price: $99.95.
Current Used Price: Not priced.

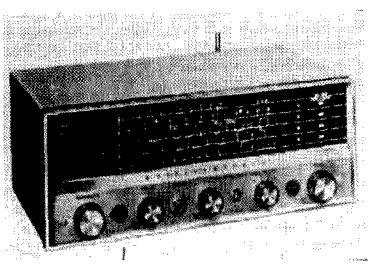
Hallicrafters S-119 & K



1961-Still Marketed.

Frequency Coverage: (1) .535 to 1.64 mc. (2) 2.0 to 5.5 mc. (3) 5.7 to 16.4 mc.
Specifications: 3 tubes plus 1 diode and selenium rectifier; ferrite rod antenna for band 1 and unbalanced antenna input for all other bands; 455 kc if; draws 16 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Internal PM speaker.
Dimensions: 10 1/2" x 5" x 7 1/2" deep.
Weight: 7 1/2 pounds.
Remarks: Available wired and tested or in kit form.
Last Amateur Net Price:
S-119 Wired Receiver........$49.95.
S-119K Kit receiver.........$39.95.
Current Used Price: $35.00.

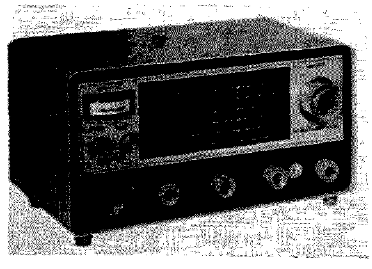
Hallicrafters S-120



1960-Still Marketed.

Frequency Coverage: .54 to 31.0 mc; (1) .54 to 1.55 mc. (2) 1.55 to 4.4 mc. (3) 4.4 to 11.0 mc. (4) 11.0 to 31.0 mc.
Specifications: 4 tubes plus rectifier; 50-600 ohm unbalanced antenna input plus loopstick on band 1 and 45" collapsable whip on all other bands; 455 kc if; draws 30 watts from 105-125 v, 50/60 cycle ac or dc line.
Special Features: Internal 5" PM speaker and electrical bandspread.
Dimensions: 13 1/2" x 5 7/8" x 8 3/4" deep.
Weight: 10 1/4 pounds.
Last Amateur Net Price: $69.95.
Current Used Price: $50.00.

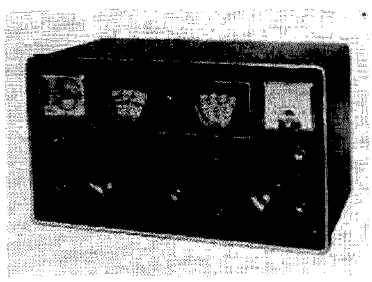
Hallicrafters SX-140 & K



1961-Still Marketed.

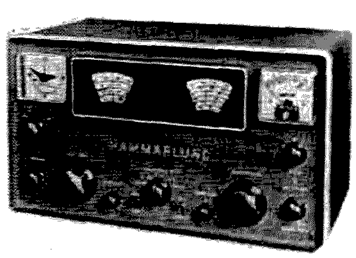
Frequency Coverage: (1) 3.5 to 4.0 mc. (2) 7.0 to 7.3 mc. (3) 14.0 to 14.4 mc. (4) 21.0 to 21.5 mc. (5) 28.0 to 29.9 mc. (6) 50.0 to 50.4 mc.
Specifications: 5 tubes plus 2 silicon diodes; 50-75 ohm unbalanced antenna input; 1650 kc if; 3.2 ohm audio output; draws 47 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Antenna trimmer, amplified S-Meter, calibration oscillator, regenerative if system and auxilliary switching terminals.
Dimensions: 13 3/8" x 7 3/16" x 8 1/4" deep.
Weight: 13 1/2 pounds.
Remarks: Available wired and tested or in kit form.
Last Amateur Net Price:
SX-140 Wired Receiver......$124.95.
SX-140K Kit Receiver.......$104.95.
Current Used Price: $92.00.

Hammarlund HQ-100A



1961-Still Marketed.
Frequency Coverage: .54 to 30.0 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4.0 mc. (3) 4.0 to 10.0 mc. (4) 10.0 to 30.0 mc.
Specifications: 8 tubes plus regulator and rectifier; 50-600 ohm balanced or unbalanced antenna input; 3.2 ohm audio output to external speaker; 455 kc if; selectivity of 6.0 kc at 6 db down and 30 kc at 60 db down with Q-Multiplier off; operates from 105-125 v, 60 cycle ac line.
Special Features: Calibrated electrical bandspread; Telechron clock timer in "AC" model; variable response audio system; antenna trimmer; Q-Multiplier; noise limiter; S-Meter and receive-standby switch.
Accessories:
S-100 Speaker.
XC-100 Crystal Calibrator.
Dimensions: 9 7/16" x 16 1/4" x 9 1/8" deep.
Shipping Weight: 33 pounds.
Last Amateur Net Price:
HQ-100A Receiver.............$189.00.
HQ-100AC Receiver............$199.00.
S-100 Speaker..................$14.95.
XC-100 Crystal Calibrator.......$15.95.
Current Used Price:
HQ-100A Receiver.............$145.00.
HQ-100AC Receiver...........$150.00.
S-100 Speaker..................$10.00.

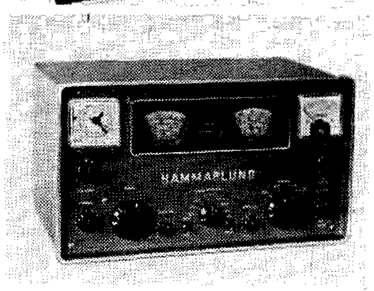
Hammarlund HQ-100 & C



1956-1961

Frequency Coverage: .54 to 30.0 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4 mc. (3) 4.0 to 10.0 mc. (4) 10.0 to 30.0 mc.
Specifications: 8 tubes plus regulator and rectifier; 50-600 ohm balanced or unbalanced antenna input; 455 kc if; selectivity of 6.0 kc at 6 db down and 30 kc at 60 db down with Q-Multiplier off; 3.2 ohm audio output to external speaker; operates from 105-125 v, 60 cycle ac line.
Special features: Calibrated electrical bandspread; Telechron clock timer in "C" model; variable response audio system; antenna trimmer; Q-Multiplier; noise limiter; S-Meter and receive-standby switch.
Accessories: S-100 Speaker.
XC-455 Crystal Controlled BFO.
Dimensions: 9 7/16" x 16 1/4" x 9 1/8" deep.
Shipping Weight: 31 pounds.
Last Amateur Net Price:
HQ-100 Receiver.................$189.00.
HQ-100C Receiver...............$199.00.
S-100 Speaker....................$14.95.
XC-455 Crystal Controlled BFO....$15.95.
Current Used Price:
HQ-100 Receiver...........$130.00.
HQ-100C Receiver..........$135.00.
S-100 Speaker..............$10.00.

Hammarlund HQ-110 & A



HQ-110: 1958-1962.
HQ-110A: 1962-Still Marketed.

NOTE: The later model HQ-110A contained minor mechanical and electrical improvements, accessory socket for preamp or converter applications, 2 meter dial calibration for use with external converter and separate 6 meter antenna input. These changes do not warrant separate description.
Frequency Coverage: (1) 1.8 to 2.0 mc. (2) 3.5 to 4.0 mc. (3) 7.0 to 7.3 mc. (4) 14.0 to 14.4 mc. (5) 21.0 to 21.6 mc. (6) 28.0 to 30.0 mc. (7) 50.0 to 50.4 mc.
Specifications: 10 tubes plus regulator and rectifier; 455 and 3045 kc if frequencies; sensitivity of 1.5 microvolts for 10 db S/N ratio; selectivity of 9.7 kc at 6 db down with Q-Multiplier off; 1 watt audio output into 3.2 ohm external speaker; draws 80 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Dual conversion superhet on frequencies above 7.0 mc; crystal controlled 2nd conversion oscillator; crystal calibrator with front panel corrector; Q-Multiplier; separate product detector for CW/SSB reception; variable response audio system; antenna trimmer; noise limiter; optional Telechron timer; S-Meter; receive-standby switch.
Accessories: S-100 Speaker.
Dimensions: 9 7/8" x 16 1/4" x 9 1/8" deep.
Shipping Weight: 30 pounds.
Last Amateur Net Price:
HQ-110 Receiver................$249.00.
HQ-110C Receiver with Telechron timer $259.00.
HQ-110A Receiver.............$249.00.
HQ-100A Rcvr. with Telechon timer $259.00.
Current Used Price:
HQ-100 Receiver ....$190.00.

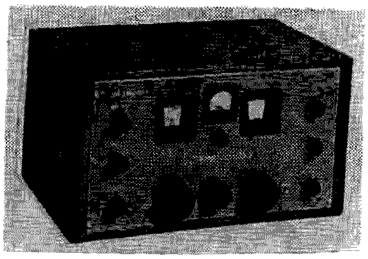
HQ-110C Receiver ....$195.00.
HQ-110A Receiver..............: $200.00.
HQ-110A Receiver with Telechron timer
$205.00.

Hammarlund HQ-129X

1946-1950

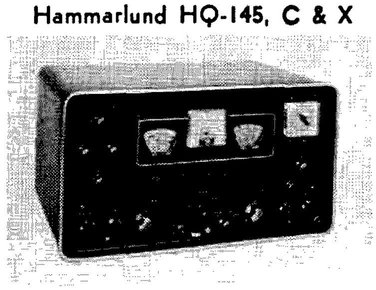
Frequency Coverage: .54 to 31.0 mc; (1) .54 to 1.32 mc. (2) 1.32 to 3.2 mc. (3) 3.2 to 5.7 mc. (4) 5.7 to 10.0 mc. (5) 10.0 to 18.0 mc. (6) 18.0 to 31.0 mc.
Specifications: 9 tubes plus regulator and rectifier; balanced or unbalanced antenna input; 455 kc if; adjustable selectivity from less than 1.0 to 10.0 kc at 6 db down; audio output of 3 watts into external 6 ohm load; operates from 105-125 v, 50/60 cycle ac line.
Special Features: Calibrated electrical bandspread; crystal filter with adjustable selectivity; noise limiter; S-Meter; antenna trimmer and receive-standby switch.
Last Amateur Net Price: $177.30.
Current Used Price: $129.00.

Hammarlund HQ-140X & XA



HQ-140X: 1953-1955.
HQ-140XA: 1955-1958.
NOTE: The later model HQ-140XA contained minor mechanical and electrical improvements. These changes do not warrant separate description.
Frequency Coverage: .54 to 31.0 mc; (1) .54 to 1.32 mc. (2) 1.32 to 3.2 mc. (3) 3.2 to 5.7 mc. (4) 5.7 to 10.0 mc. (5) 10.0 to 18.0 mc. (6) 18.0 to 31.0 mc.
Specifications: 9 tubes plus regulator and rectifier; antenna input of 100 ohms, balanced or unbalanced; 455 kc if; 2 watts audio output into external 6 ohm speaker; operates from 105-125 v, 50/60 cycle ac supply.
Special Features: Calibrated electrical bandspread; crystal filter with adjustable selectivity; S-Meter; noise limiter; antenna trimmer and receive standby switch.
Accessories: XC-100 Crystal Calibrator.
Last Amateur Net Price:
HQ-140X..............$264.50.
HQ-140XA............$249.00.
Current Used Price:
HQ-140X..............$155.00.
HQ-140XA............$165.00.

Hammarlund HQ-145, C & X



HQ-145: 1958-1961
HQ-145X: 1961-Still Marketed
NOTE: The HQ-145X model includes provisions for 1 crystal controlled channel within the tuning range of the receiver.
Frequency Coverage: .54 to 30.0 mc. (1) .54 to 1.6 mc. (2) 1.6 to 4.0 mc. (3) 4.0 to 10.0 mc. (4) 10.0 to 30.0 mc.
Specifications: 9 tubes plus regulator and rectifier; balanced or unbalanced antenna input; 455 and 3035 kc if; sensitivity of 1.75 microvolts for 10 db S/N ratio; selectivity adjustable from between .5 and 10 kc at 6 db down; audio output of 1 watt into external 3.2 ohm speaker, operates from 105-125 v. 50/60 cycle ac line.
Special Features: Double conversion superhet above 10.0 mc; crystal filter with adjustable selectivity; crystal controlled 1st conversion oscillator; notch filter; S-Meter; noise limiter; variable response audio system; calibrated electrical bandspread; Telechron clock timer optional in"C" model; receive-standby switch.
Accessories: S-200 Speaker.
XC-100P Crystal Calibrator.
Dimensions: 10 1/2"x 19" x 13" deep.
Shipping Weight: 42 pounds.
Last Amateur Net Price:
HQ-145 Receiver................$269.00.
HQ-145C Receiver with Telechron Timer
$279.00.
HQ-145X Receiver..............$269.00.
S-200 Speaker....................$19.95.
XC-100P Xtal Calibrator..........$15.95.
Current Used Price:
HQ-145 Receiver................$198.00.
HQ-145C Receiver..............$202.00.
HQ-145X Receiver..............$205.00.
S-200 Speaker....................$10.00.

Hammarlund HQ-150

1955-1958

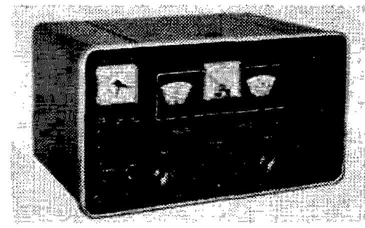
Frequency Coverage: .54 to 31.0 mc; (1) .54 to 1.32 mc. (2) 1.32 to 3.2 mc. (3) 3.2 to 5.7 mc. (4) 5.7 to 10.0 mc. (5) 10.0 to 18.0 mc. (6) 18.0 to 31.0 mc.
Specifications: 11 tubes plus regulator and rectifier; 50-300 ohm, balanced or unbalanced antenna input; 455 kc if; audio output of 2 watts into external 6 ohm speaker; operates from 105-125 v, 50/60 cycle ac line.
Special Features: Calibrated electrical bandspread; crystal filter; Q-Multiplier; crystal calibrator; S-Meter; noise limiter and receive-standby switch.
Last Amateur Net Price: $294.00.
Current Used Price: $189.00.

Hammarlund HQ-160

1958-1960

Frequency Coverage: .54 to 31.0 mc; (1) .54 to 1.32 mc. (2) 1.32 to 3.2 mc. (3) 3.2 to 5.7 mc. (4) 5.7 to 10.0 mc. (5) 10.0 to 18.0 mc. (6) 18.0 to 31.0 mc.
Specifications: 11 tubes plus regulator and rectifier; 75 ohm, balanced or unbalanced, antenna input; 455 and 3035 kc if; selectivity of 3.7 kc at 6 db down with Q-Multiplier off; audio output of 1 watt into external 3.2 ohm speaker; draws 100 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Calibrated electrical bandspread; double conversion superhet above 10.0 mc; notch filter; Q-Multiplier; product detector for CW/SSB reception; if output jack; crystal controlled 1st conversion oscillator; crystal calibrator with front panel corrector; antenna trimmer; S-Meter; noise limiter and receive-standby switch.
Last Amateur Net Price: $379.00.
Current Used Price: $265.00.

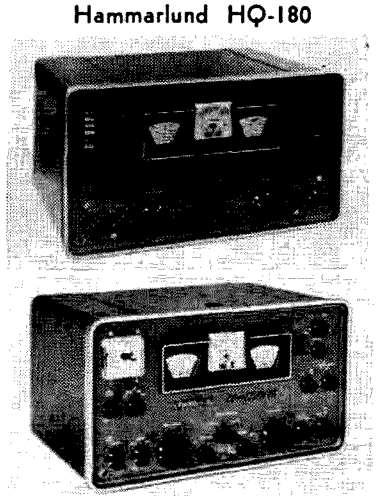
Hammarlund HQ-170



1958-Still Marketed

Frequency Coverage: (1) 1.8 to 2.0 mc. (2) 3.5 to 4.0 mc. (3) 7.0 to 7.3 mc. (4) 14.0 to 14.4 mc; (5) 21.0 to 21.6 mc. (6) 28.0 to 30.0 mc. (7) 50.0 to 54.0 mc.
Specifications: 15 tubes plus regulator and rectifier; 100 ohm balanced or unbalanced antenna input; if frequencies of 60, 455 and 3035 kc; 1 watt audio output into external 3.2 ohm speaker; sensitivity of 1.5 microvolt for 10 db S/N ratio; selectivity adjustable from .5 to 6.0 kc; draws 120 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Double conversion superhet on 160 and 80 meters, triple conversion on all other bands; adjustable selectivity with selectable sideband; vernier tuning; separate product detector for CW/SSB reception; S-Meter with amplifier stage; delayed AGC with adjustable time constant; slot filter; crystal calibrator with front panel corrector; antenna trimmer; variable response audio system; receive-standby switch with muting provisions.
Accessories: S-200 Speaker.
Dimensions: 10 1/2" x 19" x 13" deep.
Shipping Weight: 45 pounds.
Last Amateur Net Price:
HQ-170 Receiver..............$359.00.
HQ-170C Receiver with Telechron timer
$369.00.
S-200 Speaker..................$ 19.95.
Current Used Price:
HQ-170 Receiver..............$265.00.
HQ-170C Receiver............$275.00.
S-200 Speaker..................$ 10.00.

Hammarlund HQ-180



1960-Still Marketed

Frequency Coverage: .54 to 30 mc in 6 bands; bandspread calibration on 80, 40, 20, 15 and 10 meter amateur bands.
Specifications: 16 tubes plus regulator and rectifier; 72 ohm balanced or unbalanced antenna input; if frequencies of 60, 455 and 3035 kc; sensitivity of 1.5 microvolts for 10 db S/N ratio; selectivity of 1, 2 and 3 kc in LSB abd USB positions and 5, 2, 4 and 6 kc in BOTH position; audio output of 1 watt into external 3.2 ohm speaker; operates from 105-125 v, 50/60 cycle ac line.
Special Features: Double conversion superhet from .54 to 7.8 mc and triple conversion superhet from 7.8 to 30.0 mc; if system combines high frequency crystal filter and 60 kc LC filter to provide adjustable selectivity and selectable sideband reception; separate product detector for CW/SSB recept-

ion; crystal controlled first converter oscillator; delayed AGC; S-Meter with amplifier stage; slot filter; crystal calibrator with front panel corrector; adjustable noise limiter; antenna trimmer; adjustable AGC; variable response audio system; receive-standby switch with muting provisions.
Accessories: S-200 Speaker.
Dimensions: 10 1/2" x 19" x 13" deep.
Shipping Weight: 45 pounds.
Last Amateur Net Price:
HQ-180 Receiver................$429.00.
HQ-180 Receiver with Telechron timer $439.00.
S-200 Speaker..................$ 19.95.
Current Used Price:
HQ-180 Receiver.........$325.00.
HQ-180C Receiver.........$330.00.

Hammarlund PRO-310

1955-?

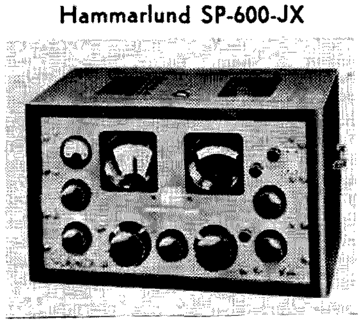
Frequency Coverage: .55 to 35.52 mc; (1) .55 to 1.11 mc. (2) 1.10 to 2.22 mc. (3) 2.20 to 4.44 mc. (4) 4.40 to 8.88 mc. (5) 8.80 to 17.76 mc. (6) 17.60 to 35.52 mc.
Specifications: 10 tubes plus regulator and 2 rectifiers; 52 and 1802 kc if frequencies; adjustable selectivity ranging from .3 kc to 4.0 kc at 6 db down to 3.8 to 13.2 kc at 60 db down.
Special Features: Differential tuning bandspread system; noise limiter; S-Meter; dual conversion above 2.2 mc; antenna trimmer; BFO buffer stage; provisions for optional crystal calibrator and receive standby switch.
Dimensions: 9" x 17 7/8" x 15 1/2" deep.
Weight: 65 pounds.
Last Amateur Net Price: $595.00.
Current Used Price: $275.00.

Hammarlund SP-400X & SX

1946-1950

Frequency Coverage:
SP-400-X..... .54 to 30 mc; (1) .54 to 1.24 mc. (2) 1.24 to 2.86 mc. (3) 2.85 to 6.3 mc. (4) 6.3 to 14.0 mc. (5) 13.4 to 30.0 mc.
SP-400-SX.....1.25 to 40.0 mc; (1) 1.25 to 2.5 mc. (2) 2.5 to 5.0 mc. (3) 5.0 to 10.0 mc. (4) 10.0 to 20.0 mc. (5) 20.0 to 40.0 mc.
Specifications: 16 tubes plus 2 rectifiers; antenna input of 100 ohms balanced or unbalanced; 455 kc if; 500 ohm audio output to external speaker; draws 180 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Electrical bandspread; external power supply; S-Meter; noise limiter; crystal filter with adjustable selectivity; adjustable if selectivity; antenna trimmer; phono input; receive-standby switch.
Last Amateur Net Price: $450.00.
Current Used Price: $155.00.

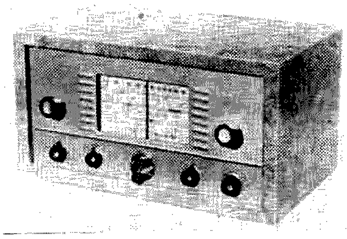
Hammarlund SP-600-JX



1950-Still Marketed

Frequency Coverage: .54 to 54.0 mc; (1) .54 to 1.35 mc. (2) 1.35 to 3.45 mc. (3) 3.45 to 7.4 mc. (4) 7.4 to 14.8 mc. (5) 14.8 to 29.7 mc. (6) 29.7 to 54.0 mc.
Specifications: 18 tubes plus regulator and rectifier; 100 ohm balanced antenna input; 455 and 3955 kc if frequencies; sensitivity of better than 2.3 microvolts for 10 db S/N ratio; image rejection of better than 80 db; 2.5 watts audio output into external 600 ohm load; draws 130 watts from 95/105/117/130 190/210/234/260 v, 50/60 cycle ac line.
Special Features: Double conversion superhet above 7.4 mc; crystal controlled 2nd conversion oscillator; variable and crystal controlled first conversion oscillators with provisions for 6 crystals; crystal filter with adjustable bandwidth of .2, .5, 1.3, 8.0, and 13.0 kc at 6 db down; S-Meter with spring return switch to monitor audio output level; noise limiter; ac convenience outlet; phono input; if output jack; send-receive switch with relay socket.
Table Model Dimensions: 12 3/4" x 21 3/8" x 17 1/8" deep.
Table Model Weight: 87 1/2 pounds.
Last Amateur Net Price: $1140.00.
Current Used Price: Price varies widely.

Heath AR-1, 2 & 3



AR-1

SIMILAR TO MODEL AR-2, no photograph or further information available.
Current Used Price: $10.00.

AR-2

1953-1955

Frequency Coverage: .55 to 35 mc in 4 bands.
Specifications: 5 tubes plus rectifier; 455 kc if; draws 45 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Self contained speaker, calibrated electrical bandspread, and noise limiter.
Dimensions: 11 1/2" x 5 3/4" x 6 3/4" deep.
Shipping Weight: 12 pounds.
Last Amateur Net Price: AR-2 Communications Receiver Kit, less cabinet..$25.50.
AR-2 Cabinet.................... $ 4.50.
Current Used Price: AR-2 Communications Receiver with cabinet..............$15.00.
Remarks: No photograph available, resembles Model AR-3.

AR-3

1955-1961

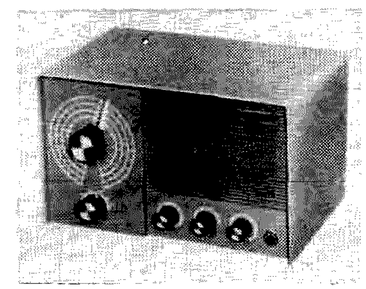
Frequency Coverage: .55 to 30 mc; (1) .55 to 1.5 mc. (2) 1.5 to 4.0 mc. (3) 4.0 to 10.0 mc. (4) 10.0 to 30.0 mc.
Specifications: 4 tubes plus rectifier; 455 kc if; draws 40 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Self contained speaker, calibrated electrical bandspread, and noise limiter.
Dimensions: 11 1/2" x 5 3/4" x 6 3/4" deep.
Shipping Weight: 12 pounds.
Last Amateur Net Price: AR-3 Communications Receiver Kit, less cabinet.$29.95.
AR-3 Cabinet.................... $ 4.95.
Current Used Price: AR-3 Communications Receiver with cabinet.........$20.00.

Heath GC-1 & GC-1A

1959-Still Marketed

Frequency Coverage: .55 to 32 mc; (1) .55 to 1.6 mc. (2) 1.6 to 4.0 mc. (3) 4.0 to 9.0 mc. (4) 9.0 to 20.0 mc. (5) 20.0 to 32.0 mc.
Specifications: 10 transistors plus 6 diodes; self contained whip and high impedance unbalanced antenna input; 455 kc if; sensitivity of 10 microvolts for 10 db S/N ratio at 50 mw audio output on broadcast band, 2 microvolts on all other bands; selectivity of 3 kc at 6 db down; 400 mw audio output at 10% distortion into 35 ohm speaker or low impedance phones; draws 35 ma for 50 mw audio output from 12 v dc source of 8 size "C" cells or accessory ac supply.
Special Features: Self contained speaker, self contained whip antenna, calibrated electrical bandspread, ceramic filter if system, dial light switch, noise limiter, S-Meter and antenna trimmer.
Accessories: XP-2 117 v ac power supply.
Dimensions: 12" x 6 7/8" x 10" deep.
Weight: 17 pounds.
Last Amateur Net Price:
GC-1A Receiver Kit.............$109.95.
GC-1A Receiver, wired and tested$193.50.
XP-2 Power Supply Kit.......... $ 9.95.
Current Used Price:
GC-1A Receiver, less ac power supply... $ 85.00.
GC-1A Receiver with XP-2 Power Supply $ 95.00.

Heath GR-81



1961-Still Marketed.

Frequency Coverage: 140 kc to 18 mc.
Specifications: 2 tubes plus rectifier; long and short single wire antenna input; 1 watt audio output; draws 30 watts from 117 v, 50/60 cycle ac line.
Special Features: Regenerative detector, audio and power supply "basic" receiver; self contained speaker.
Dimensions: 10" x 7" x 7" deep.
Weight: 9 3/4 pounds.
Last Amateur Net Price:
GR-81 Receiver Kit.........$24.95.
Current Used Price:
GR-81 Receiver......Not Priced.

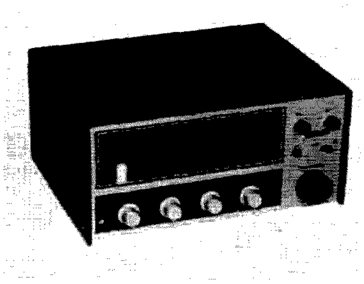
Heath GR-91

1961--Still Marketed.

Frequency Coverage: .55 to 30 mc; (1).55 to 1.6 mc. (2) 1.6 to 4.0 mc. (3) 4.0 to 10.0 mc. (4) 10.0 to 30.0 mc.
Specifications: 4 tubes plus rectifier; 75 ohm unbalanced and 300 ohm balanced antenna input; 455 kc if; draws 30 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Electrical bandspread, internal speaker, S-Meter, noise limiter

and Q-Multiplier jack.
Dimensions: 12 1/4" x 5 1/4" x 8 1/4" deep.
Weight: 9 pounds.
Last Amateur Net Price:
GR-91 Receiver Kit.............$39.95.
Current Used Price:
GR-91 Receiver..........Not Priced.

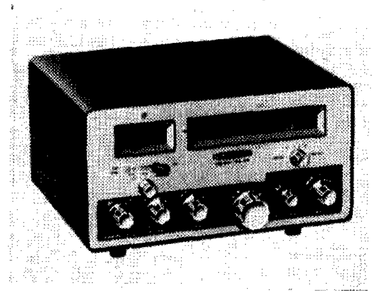
Heath HR-10



1961-Still Marketed.

Frequency Coverage: (1) 3.5 to 4.0 mc. (2) 7.0 to 7.3 mc. (3) 14.0 to 14.4 mc. (4) 21.0 to 21.5 mc. (5) 28.0 to 29.9 mc.
Specifications: 6 tubes plus rectifier; 1680 kc if; requires 105-125 v, 50/60 cycle ac power.
Special Features: Crystal lattice filter, provisions for internal crystal calibrator, S-Meter, accessory and muting socket, antenna trimmer and noise limiter.
Accessories: Model HRA-10-1 100 kc crystal calibrator.
Shipping Weight: 21 pounds.
Last Amateur Net Price:
HR-10 Basic Amateur Receiver Kit..$82.95.
HRA-10-1 Crystal Calibrator Kit....$ 8.95.
Current Used Price:
HR-10 Receiver.............Not Priced.

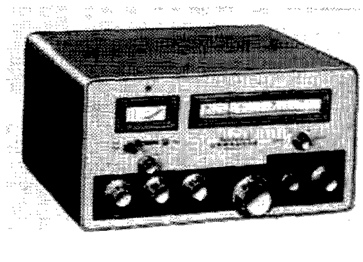
Heath HR-20



1962-Still Marketed.

Frequency Coverage: (1) 3.5 to 4.0 mc. (2) 7.0 to 7.3 mc. (3) 14.0 to 14.35 mc. (4) 21.0 to 21.5 mc. (5) 28.0 to 29.7 mc.
Specifications: 7 tubes plus voltage regulator; 50-75 ohm unbalanced antenna input; sensitivity of less than 1 microvolt for 10 db S/N ratio; selectivity of 3 kc at 6 db down and 10 kc at 60 db down; requires 6 or 12 v, ac or dc heater supply and draws 85 to 125 ma from external 275 to 350 v dc supply.
Special Features: 3 mc crystal filter, crystal controlled BFO with selectable sideband, SSB/CW product detector, S-Meter, noise limiter and antenna trimmer.
Accessories:
AK-6 Mobile Base Mount Kit.
AK-75" PM Mobile Speaker Kit.
HP-10 Transistorized Mobile Power Supply Kit.
HP-20 AC Power Supply Kit.
Dimensions:
HR-20 Single Sideband Receiver..........
12 1/8" x 6 1/8" x 9 15/16" deep.
AK-7 Mobile Speaker....................
5" x 5" x 2 1/2" deep.
HP-10 Mobile Power Supply.............
8" x 7 1/2" x 6 1/2" deep.
HP-20 AC Power Supply.................
9" x 4 3/4" x 6".
Weight:
HR-20 Single Sideband Rcvr....20 pounds.
AK-7 Mobile Speaker...........5 pounds.
HP-10 Mobile Power Supply....10 pounds.
HP-20 AC Power Supply.......14 pounds.
Last Amateur Net Price:
HR-20 Single Sideband Rcvr.....$134.50.
AK-6 Base Mount Kit...........$ 4.95.
AK-7 Mobile Speaker Kit........$ 5.95.
HP-10 Mobile Power Supply Kit..$ 44.95.
HP-20 AC Power Supply Kit......$ 24.95.

Heath MR-1



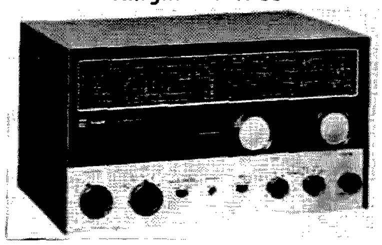
1959-Still Marketed.
Frequency Coverage: (1) 3.5 to 4.0 mc. (2) 7.0 to 7.3 mc. (3) 14.0 to 14.35 mc. (4) 21.0 to 21.5 mc. (5) 28.0 to 29.7 mc.
Specifications: 7 tubes plus voltage regulator; 52 ohm unbalanced antenna input; 3.0 mc if; sensitivity of less than 1 microvolt for 10 db S/N ratio; selectivity of 3 kc at 6 db down and 10 kc at 60 db down; draws 3.30 at 6.3 v or 1.65 at 12.6 v ac or dc and 125 ma at 300 v dc from external power source.
Special Features: 3 mc crystal filter, SSB/CW product detector, S-Meter, noise limiter and antenna trimmer.
Accessories: AK-75" PM Mobile Speaker Kit.
AK-6 Mobile Base Mount Kit.
HP-10 Transistorized Mobile Power Supply Kit.
HP-20 AC Power Supply Kit.
Dimensions:
MR-1 Mobile Receiver.....12 1/8" x 6 1/2" x 9 15/16" deep.
AK-7 Mobile Speaker.....5" x 5" x 2 1/2" deep.
HP-10 Mobile Power Supply.....8" x 7 1/2" x 6 1/2" deep.
HP-20 AC Power Supply.....9" x 4 3/4" x 6".
Weight: MR-1 Mobile Receiver...19 pounds.
AK-7 Mobile Speaker..........5 pounds.
HP-10 Mobile Power Supply...10 pounds.
HP-20 AC Power Supply.......14 pounds.
Last Amateur Net Price:
MR-1 Mobile Rcvr. Kit..........$129.95.
AK-6 Mobile Base Mount Kit.....$ 4.95.
AK-7 Mobile Speaker Kit........$ 5.95.
HP-10 Mobile Power Supply Kit..$ 44.95.
HP-20 AC Power Supply Kit......$ 24.95.
Current Used Price:
MR-1 Mobile Receiver..........$105.00.
HP-10 Mobile Power Supply.....$ 25.00.
HP-20 AC Power Supply........ $ 32.00.

Heath RX-1

1958-Still Marketed.

Frequency Coverage: (1) 1.8 to 2.0 mc. (2) 3.5 to 4.0 mc. (3) 7.0 to 7.3 mc. (4) 14.0 to 14.35 mc. (5) 21.0 to 21.45 mc. (6) 29.96 to 27.23 mc. (7) 28.0 to 29.7 mc.
Specifications: 13 tubes plus regulator and rectifier; 50-72 ohm unbalanced and 150-300 ohm balanced antenna input; 50 and 1682 kc if; sensitivity of less than 1 microvolt for 10 db S/N ratio; adjustable selectivity of 5.0, 3.0, 2.0, 1.0 and 0.5 kc; 2 watts audio output into external 8 or 500 ohm speaker; draws 75 watts from 117 v, 50/60 cycle ac line.
Special Features: Calibrated scales for 6 and 2M coverage with external convertors, dual conversion if system with selectable sideband, notch filter, product detector for SSB/CW, internal crystal calibrator, S-Meter, noise limiter and accessory socket.
Accessories: AK-5 8" PM Speaker Kit.
Dimensions: 19 1/2" x 11 5/8" x 16" deep.
Weight: 52 pounds.
Last Amateur Net Price:
RX-1 Receiver Kit..............$299.95.
AK-5 Speaker Kit...............$ 10.95.
Current Used Price:
RX-1 Receiver less speaker.....$230.00.
RX-1 Receiver with AK-5 Speaker........ $237.00.

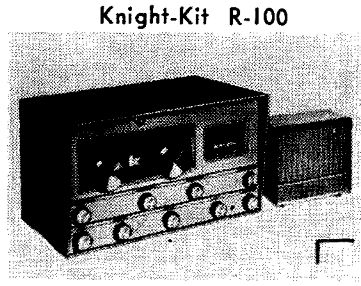
Knight-Kit R-55



1960-1962

Frequency Coverage: .55 to 36 and 47 to 54 mc; (1) .55 to 19mc. (2) 1.9 to 6.0 mc. (3) 6.0 to 15.0 mc. (4) 13.0 to 36.0 mc. (5) 47.0 to 54.0 mc.
Specifications: 5 tubes plus rectifier; 50 ohm antenna input; 1650 if; sensitivity ranges from 4 microvolts on 80M to 10 microvolts on 6M; draws 60 watts from 117vac line.
Special Features: Internal speaker, calibrated electrical bandspread, flywheel tuning, noise limiter and antenna trimmer.
Accessories: X-10 Crystal Calibrator.
Dimensions: 14 1/4" x 8 5/8" x 11" deep.
Last Amateur Net Price:
R-55 Receiver in kit form.......$59.95
X-10 Crystal Calibrator in kit.... 10.95
Current Used Price:
R-55 Rec. with X-10 Xtal Cal.....70.00
R-55 Rec. less X-10 Xtal Cal.....67.50

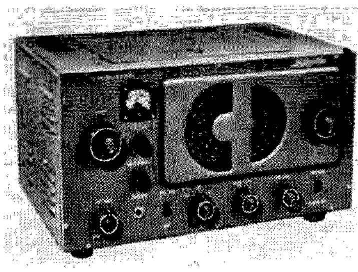
Knight-Kit R-100



1958-1961

Frequency Coverage: 540 kc to 30 mc in 4 bands.
Specifications: 7 tubes plus regulator and rectifier; 50-300 ohm balanced or unbalanced antenna input; 455 kc if; sensitivity ranges from .75 microvolt on 80-40M to 1.5 microvolts on 10M for 10 db S/N ratio; Q multiplier provides adjustable selectivity from 300 cps to 4.5 kc at 6 db down; requires 110-125 v, 60 cycle ac power.
Special Features: Noise limiter, calibrated electrical bandspread, Q multiplier null and peak, regulated B+ to HFO, delayed AVC, antenna trimmer and exalted BFO injection.
Accessories: S-8 Speaker Kit, M-5 S-Meter Kit and Crystal Calibrator Kit.
Dimensions: 16 1/8" x 9 5/8" x 10 3/4" deep.
Shipping Weight: 31 pounds.
Last Amateur Net Price:
R-100 Receiver kit..............$99.95
S-8 Speaker kit................. 9.95
M-5 S-Meter kit................ 12.95
X-10 Xtal Calibrator kit......... 10.95
Current Used Price:
R-100 Rec. with all accessories.. 85.00
R-100 Rec. less all accessories.. 74.00

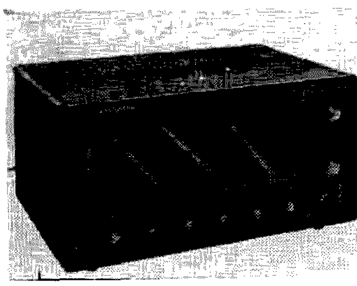
Lafayette KT-200 & HE-10WX



1959-Still Marketed.

Frequency Coverage: .55 to 31 mc; (1) .55 to 1.6 mc. (2) 1.6 to 4.8 mc. (3) 4.8 to 14.5 mc. (4) 10.5 to 31.0 mc.
Specifications: 8 tubes plus rectifier; 455 kc if; sensitivity of 1.25 microvolts for 10 db S/N ratio; selectivity of ±10 kc at 60 db down; 1.5 watts audio output into external 4 or 8 ohm speaker; requires 100-125 v, 50/60 cycle ac power.
Special Features: Electrical bandspread, noise limiter and S-Meter.
Accessories: HE-11 4" PM speaker.
Dimensions: 15 1/2" x 8 1/2" x 12" deep.
Shipping Weight: 22 pounds.
Last Amateur Net Price:
KT-200WX Receiver Kit..........$64.50.
HE-10WX wired and tested rcvr...$79.95.
HE-11 Speaker..................$ 7.95.
Current Used Price:
HE-10WX Rcvr., less speaker....$55.00.
HE-10WX Rcvr. with HE-11 Speaker......$63.00.

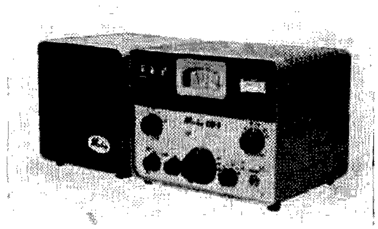
Lafayette KT-320 & HE-30WX



1960-Still Marketed.

Frequency Coverage: .55 to 30 mc; (1) .55 to 1.6 mc. (2) 1.6 to 4.8 mc. (3) 4.8 to 14.5 mc. (4) 10.3 to 30.0 mc.
Specifications: 8 tubes plus rectifier; 455 kc if; sensitivity of 1 microvolt for 10 db down with Q-Multiplier, 10 kc at 60 db down; 1.5 watts audio output into external 4 or 8 ohm speaker; draws 50 watts from 105-120 v, 60 cycle ac line.
Special Features: Calibrated electrical bandspread, noise limiter, S-Meter, Q-multiplier and antenna trimmer.
Accessories: HE-11 4" PM speaker.
Dimensions: 15" x 7" x 10" deep.
Shipping Weight: 25 pounds.
Last Amateur Net Price:
KT-320 Receiver Kit.............$79.95.
HE-30WX wired and tested rcvr...$99.95.
HE-11 Speaker..................$ 7.95.
Current Used Price:
HE-30WX Receiver, less speaker. $60.00.
HE-30WX Rcvr. with HE-11 Speaker......$68.00.

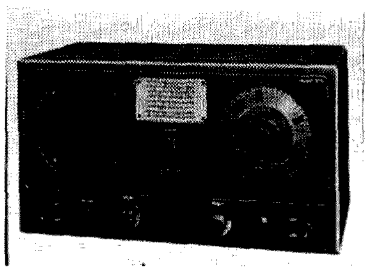
Mosley CM-1



1961-Still Marketed.

Frequency Coverage: Amateur band coverage 80 through 10M with 15 mc WWV band.
Specifications: 5 tubes plus 4 diodes; 3.5-4.1 mc tunable if and 455 kc fixed if; sensitivity of 0.5 microvolt for 10 db S/N ratio on 10M; selectivity of 2.5 kc at 6 db down; draws 33 watts from 115 v, 50/60 cycle ac line.
Special Features: Double conversion superhet with tunable if, product detector, S-Meter, noise limiter, muting terminals and accessory socket.
Accessories: CMS-1 Speaker; 5 crystals are provided and export, 230 volt, 50/60 cycle model is available.
Dimensions: CM-1 Receiver: 10 1/2" x 7 1/2" x 8" deep.
CMS-1 Speaker: 7 1/2" x 7 1/2" x 8" deep.
Weight: CM-1 Receiver: 14 pounds.
CMS-1 Speaker: 4 pounds.
Last Amateur Net Price:
CM-1 Receiver: $169.95.
CMS-1 Speaker: $ 16.95.
Current Used Price:
CM-1 Receiver with speaker......$117.00.

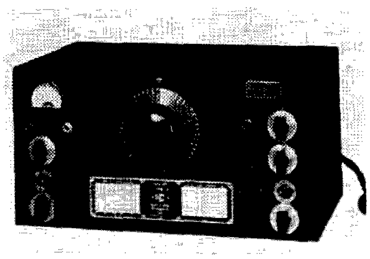
National HFS



1948-1951

Frequency Coverage: 27 to 250 mc in 6 bands using plug-in coils.
Specifications: Complete receiver using super-regenerative detector or used as a tunable converter with conventional superhet receiver tuning 10.6 mc. Required separate power supply or battery source.
Special Features: Internal speaker and super-regenerative detector.
Accessories: Type 5881 AC Power Supply.
Type 686S 6 Volt DC Power Supply.
Last Amateur Net Price: HFS Rcvr..$125.00
Type 5886 Power Supply............$ 37.3P
Current Used Price: HFS Receiver with Type 5886 Power Supply...........$70.00.

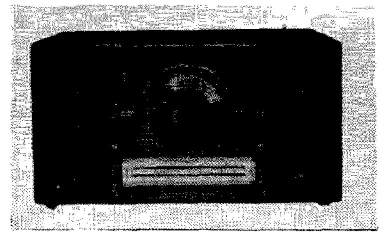
National HRO-5



1946-1948

Frequency Coverage: 50 to 430 kc and .48 to 30 mc; coil sets A, B and C supplied with basic receiver with the rest as optional equipment: (A) 14.0 to 30.0 mc. (B) 7.0 to 14.4 mc. (C) 3.5 to 7.3 mc. (D) 1.7 to 4.0 mc. (E) .90 to 2.05 mc. (F) 480 to 960 kc. (G) 180 to 430 kc. (H) 100 to 200 kc. (J) 50 to 100 kc.
Specifications: 11 tubes plus rectifier; antenna input of between 300 and 600 ohms, balanced or unbalanced, dependent on frequency; 456 kc if; selectivity adjustable between .2 and 6.5 kc at 5 db down and 3 and 21 kc at 60 db down; audio output of 5,000 ohms into external output transformer and speaker; draws 70 watts from 115/230 v, 50/60 cycle ac line using the #697 Power Supply and 6.3 amperes at 6 v dc using the #686S Power Supply.
Special Features: Switched bandspread on 80, 40, 20 and 10 meters, noise limiter, crystal filter, S-Meter and standby switch.
Accessories: Type 697 AC Power Supply.
Type 686S 6 volt Power Supply.
Type MCS Table Model Speaker.
Type RFSH Rack Mounted Speaker.
Last Amateur Net Price:
HRO-5 Receiver................$274.35.
Type 697 AC Power Supply.......$ 20.35.
Type MCS Speaker..............$ 12.00.
Current Used Price: HRO-5 Receiver with AC Power Supply and Speaker....$ 85.00.

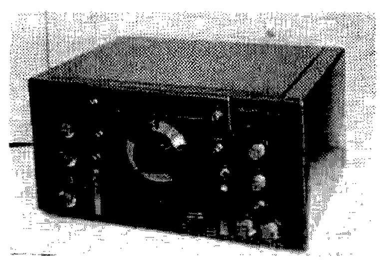
National HRO-7



1947-1949

Frequency Coverage: 50 to 430 kc and .48 to 30.0 mc; coil sets A, B, C and D supplied with basic receiver with the rest available as optional equipment: (A) 14.0 to 30.0 mc. (B) 7.0 to 14.4 mc. (C) 3.5 to 7.3 mc. (D) 1.7 to 4.0 mc. (E) .90 to 2.05 mc. (F) 480 to 960 kc. (G) 180 to 430 kc. (H) 100 to 200 kc. (J) 50 to 100 kc.
Specifications: 11 tubes plus regulator and rectifier; antenna input of between 300 and 600 ohms, balanced or unbalanced, dependent on frequency; 456 kc if; selectivity adjustable between .2 and 6.5 kc at 6 db down and 3 and 21 kc at 60 db down; audio output of 5,000 ohms into external output transformer and speaker; draws 74 watts from 115/230 v, 50/60 cycle ac line using the #697 Power Supply and 6.5 amperes at 6 v using the #686S Power Supply.
Special Features: Switched bandspread on 80, 40, 20 and 10 meters, noise limiter, crystal filter, S-Meter, tone control, temperature compensated oscillator, accessory socket and standby switch.
Accessories: Type 697 AC Power Supply
Type 686S 6 volt Power Supply.
Type MCR Table Model Speaker.
Type RFSH Rack Mounted Speaker.
Last Amateur Net Price: HRO-7 Receiver with Type 697 Power Supply and MCR Speaker.............................$311.36.
Current Used Price: HRO-7 Receiver with power supply and speaker. .....$125.00.

National HRO-50

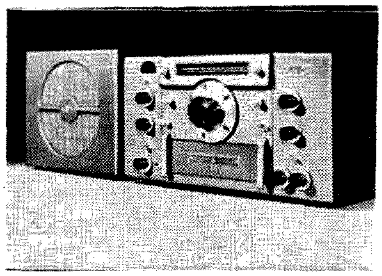


1949-1951

Frequency Coverage: 50 to 430 kc and .48 to 35.0 mc; (A) 14.0 to 30.0 mc. (B) 7.0 to 14.4 mc. (C) 3.5 to 7.3 mc. (D) 1.7 to 4.0 mc. (E) .90 to 2.05 mc. (F) 480 to 960 kc. (G) 180 to 430 kc. (H) 100 to 200 kc. (J) 50 to 100 kc. (AA) 27.5 to 30.0 mc. (AB) 25.0 to 35.0 mc. (AC) 21.0 to 21.5 mc.
Specifications: 12 tubes plus regulator and rectifier; 300 to 600 ohm nominal antenna impedance, balanced or unbalanced; 455 kc if; audio output of 8 watts into external 8 500/600 ohm speaker; draws 115 watts

from 110-120 or 220-240 v, 50/60 cycle ac line.
Special Features: Calibrated electrical bandspread; noise limiter; crystal filter; S-Meter; tone control; temperature compensated HFO; dial light dimmer; antenna trimmer; standby switch; accessory/external power socket; provisions for internal crystal calibrator and NBFM adaptor.
Accessories: HRO-50TS Table Model Speaker.
NFM-50 Narrow-Band FM Adaptor.
XCU Crystal Calibrator.
SOJ-3 Select-O-Ject.
650S Vibrator Power Supply.
HRO-50RS Rack Mounted Speaker.
Last Amateur Net Price:
HRO-50 Receiver................$349.00.
HRO-50TS Speaker..............$ 15.00.
XCU Crystal Calibrator..........$ 19.95.
Current Used Price: HRO-50 Receiver with speaker and Crystal Calibrator....$190.00.

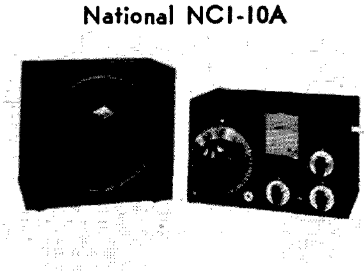
National HRO-60



1952-Still Marketed.

Frequency Coverage: 50 to 430 kc and .48 to 54.0 mc coils available. Receiver supplied with 1.7 to 30 mc coils which may be switched to provide bandspread coverage on 80, 40, 20 and 10 meters.
Specifications: 15 tubes plus filament regulator, voltage regulator and rectifier: 456 and 2010 kc if; sensitivity better than 1 microvolt for 10 db S/N ratio; selectivity adjustable from .08 to 3.5 kc at 6 db down; operates from 115/230 v, 50/60 cycle ac line.
Special Features: Dual conversion superhet above 7.0 mc; calibrated electrical band spread; noise limiter; crystal filter; filament and B+ regulation on HFO; provision for crystal calibrator with front panel control; tone control; antenna trimmer; S-Meter; phono jack; provisions for narrow band FM adaptor; auxiliary power socket; high fidelity audio system and receive-standby switch.
Accessories: HRO-60TS Speaker
XCU-2 Crystal Calibrator
NFM-83-60 NFM Adaptor.
Dimensions: 10 1/8" x 19 3/4" x 16 1/2" deep.
Weight: 88 pounds.
Last Amateur Net Price:
HRO-60 Receiver.. ....$745.00.
XCU-2 Crystal Calibrator.....$ 29.95.
NFM-83-60 NFM Adaptor......$ 33.95.
HRO-60TS Speaker..... .. ...$ 19.95.
Current Used Price:
HRO-60 Receiver........ .. .$325.00.
HRO-60TS Speaker... .. ..$ 10.00.

National NC1-10A



1946-1948

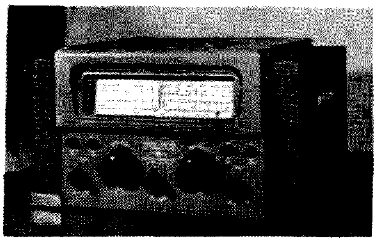
Frequency Coverage: 27 to 290 mc with sets of plug-in coils.
Specifications: 4 tubes; balanced or unbalanced antenna, 7000 ohm audio output transformer and speaker; operates from batteries or #5886 Power Supply.
Special Features: TRF circuit with super-regenerative detector.
Accessories: Type 5886 Power Supply.
Last Amateur Net Price:
NC-1-10A Receiver..............$67.50.
Type 5886 Power Supply..........$22.43.
Current Used Price: NC-1-10A Receiver with power supply... ....$40.00.

National NC-33

1948-1950

Frequency Coverage: 500 kc to 35 mc in 4 bands.
Specifications: Operates from 110-120 v, 50/60 cycle ac or dc line.
Special Features: Internal speaker; electrical bandspread; noise limiter and receive-standby switch.
Last Amateur Net Price: $65.95.
Current Used Price: $25.00.

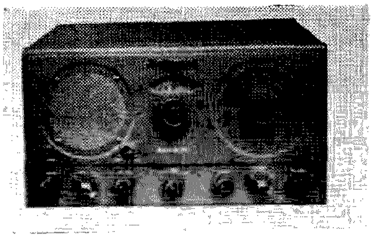
National NC-46



1946-1949

Frequency Coverage: .54 to 30.0 mc; (1) .54 to 1.6 mc. (2) 1.55 to 4.6 mc. (3) 4.4 to 12.0 mc. (4) 11.5 to 30.0 mc.
Specifications: 9 tubes plus rectifier; balanced or unbalanced antenna input; 455 kc if; 4 watts audio output into external 10 ohm speaker; draws 65 watts from 110-130 v, 50/60 cycle ac or dc line.
Special Features: Bandspread tuning; noise limiter; tone control and external muting terminals.
Last Amateur Net Price: $97.50.
Current Used Price: $30.00.

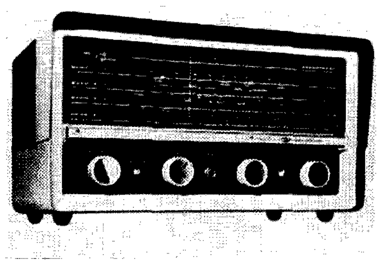
National NC-57



1947-1950

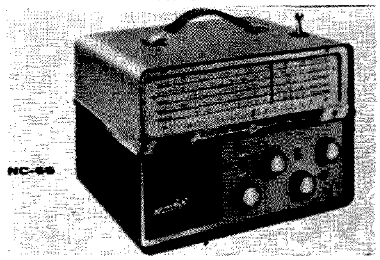
Frequency Coverage: .54 to 55.0 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4.65 mc. (3) 4.65 to 13.5 mc. (4) 13.5 to 35.0 mc. (5) 35.0 to 55.0 mc.
Specifications: 7 tubes plus regulator and rectifier; 300 ohm nominal, balanced or unbalanced, antenna input; 455 kc if; draws 84 watts from 105-130 v, 50/60 cycle ac line.
Special Features: Self-contained speaker; electrical bandspread; noise limiter; antenna trimmer and accessory/power socket.
Accessories: SM-57 Tuning Meter.
Last Amateur Net Price: $89.50.
Current Used Price: $52.00.

National NC-60



1958-Still Marketed.
Frequency Coverage: .54 to 31.0 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4.5 mc. (3) 4.0 to 12.0 mc. (4) 10.5 to 31.0 mc.
Specifications: 4 tubes plus rectifier; unbalanced antenna input; 455 kc if; operates on 115 v, 50/60 cycle ac or dc line.
Special Features: Internal speaker; electrical bandspread and receive-standby switch.
Dimensions: 7 5/8" x 13 1/2" x 8 5/8" deep.
Weight: 15 pounds.
Last Amateur Net Price: $59.95.
Current Used Price: $45.00.

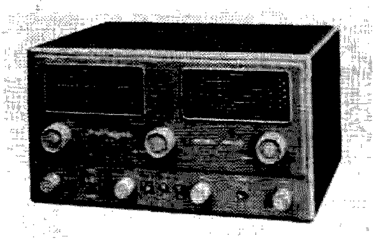
National NC-66



1957-1961

Frequency Coverage: 150 to 400 kc and .5 to 23.0 mc; (1) 150 to 400 kc. (2) .5 to 1.4 mc. (3) 1.4 to 4.05 mc. (4) 4.0 to 11.4 mc. (5) 11.0 to 23.0 mc.
Specifications: 5 tubes plus selenium rectifier; ferrite loop antenna for bands 1 and 2 with whip for other bands; external antenna input of 50-300 ohms unbalanced; operates on 115 v ac or self-contained batteries; 220 v ac operation possible with accessory adaptor.
Special Features: Internal speaker; electrical bandspread; provisions for external direction finder for low frequency bands and receive-standby switch.
Accessories: RDF-66 Direction Finder Loop. 220 v Adaptor.
Dimensions: 9 11/16" x 12 5/16" x 10" deep.
Shipping Weight: 16 pounds.
Last Amateur Net Price:
NC-66 Receiver...................$129.95.
RDF-66 Direction Finder..........$ 17.00.

National NC-88

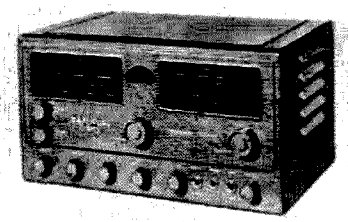


1953-1954

Frequency Coverage: .54 to 40 mc. (1) .54 to 1.6 mc. (2) 1.6 to 4.7 mc. (3) 4.7 to 15.0 mc. (4) 14.0 to 40.0 mc.
Specifications: 8 tubes plus rectifier; 1.5 watts audio output to internal 3.2 ohm speaker.

Special Features: Calibrated electrical bandspread; internal speaker; antenna trimmer, tone control; phono input; noise limiter and receive-standby switch.
Last Amateur Net Price: $99.95.
Current Used Price: $80.00.

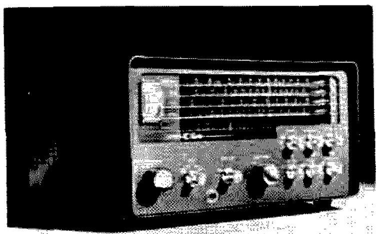
National NC-98



1954-1956

Frequency Coverage: .54 to 40.0 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4.7 mc. (3) 4.7 to 15.0 mc. (4) 14.0 to 40.0 mc.
Specifications: 8 tubes plus rectifier; 455 kc if; 1 rf and 2 if stages.
Special Features: Calibrated electrical bandspread; crystal filter; tone control; S-Meter; delayed AVC; antenna trimmer; noise limiter; phono input and receive-standby switch.
Last Amateur Net Price: $149.95.
Current Used Price: $96.00.

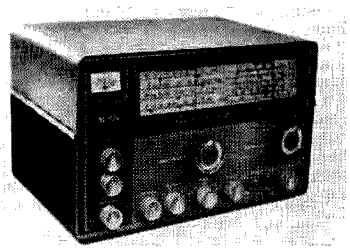
National NC-105



1961-Still Marketed.

Frequency Coverage: .55 to 30 mc; (1) .55 to 1.6 mc. (2) 1.6 to 4.5 mc. (3) 4.0 to 12.0 mc. (4) 11.0 to 30.0 mc.
Specifications: 5 tubes plus rectifier; 50-300 ohms antenna input; 455 kc if; 3.2 ohm audio output to internal speaker; draws 49 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Internal speaker; Q-Multiplier; separate product detector for CW/SSB reception; noise limiter; electrical bandspread; S-Meter and AGC on all modes of reception.
Dimensions: 7 5/8" x 13 1/2" x 8 5/8" deep. (Steel cabinet model.)
Shipping Weight: 28 pounds.
Last Amateur Net Price:
NC-105, steel cabinet: $119.95.
NC-105W, Wood cabinet: $139.95.
Current Used Price: NC-105......$92.00.

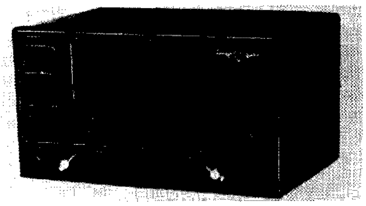
National NC-109



1957-1960

Frequency Coverage: .54 to 40.0 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4.7 mc. (3) 4.7 to 15.0 mc. (4) 14.0 to 40.0 mc.
Specifications: 9 tubes plus regulator and rectifier; 50-300 ohm, balanced or unbalanced, antenna input; 455 kc if; sensitivity of 1 to 2 microvolts for 10 db S/N ratio: selectivity of from .2 to 5.2 kc at 6 db down to 10 to 29.5 kc at 60 db down; 1.5 watts audio output into external 3.2 ohm speaker.
Special Features: Calibrated electrical bandspread; crystal filter; S-Meter; separate product detector for CW/SSB reception; noise limiter; antenna trimmer; tone control; phono jack and accessory socket.
Accessories: XCU Crystal Calibrator. NFM-83-60 Narrow Band FM Adaptor. Table Model Speaker.
Dimensions: 10" x 16 13/16" x 10 7/8" deep.
Shipping Weight: 35 pounds.
Last Amateur Net Price:
NC-109 Receiver...............$199.95.
Matching Speaker..............$ 17.50.
Current Used Price:
NC-109 Receiver with speaker...$125.00.

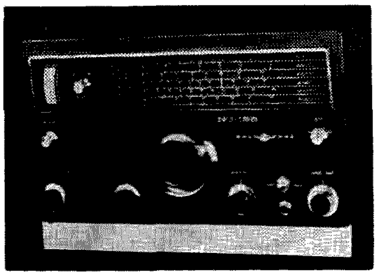
National NC-125



1950-1956

Frequency Coverage: .56 to 35.0 mc; (1) .56 to 1.6 mc. (2) 1.6 to 4.4 mc. (3) 4.4 to 13.0 mc. (4) 12.0 to 36.0 mc.
Specifications: 9 tubes plus regulator and rectifier; sensitivity of 3 microvolts on 10 meter band for 10 db S/N ratio.
Special Features: Select-O-Ject audio circuit; S-Meter; antenna trimmer; noise limiter; tone control and receive-standby switch.
Accessories: NC-125TS Speaker.
Last Amateur Net Price:
NC-125 Receiver.............$149.50.
NC-125TS Speaker............$ 11.00.
Current Used Price:
NC-125 Receiver.............$ 95.00.
NC-125TS Speaker............$ 10.00.

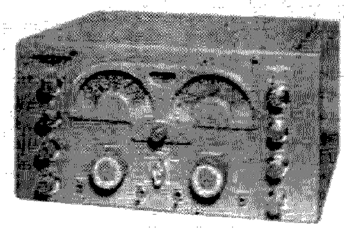
National NC-155



1961-Still Marketed.

Frequency Coverage: (10 3.5 to 4.0 mc. (2) 7.0 to 7.3 mc. (3) 14.0 to 14.35 mc. (4) 21.0 to 21.5 mc. (5) 28.0 to 30.0 mc. (6) 50.0 to 54.0 mc.
Specifications: 8 tubes plus rectifier and regulator; coaxial antenna input; 230 and 2215 kc if; 1 watt at 10% distorion audio output to 3.2 ohm load; sensitivity of better than 1 microvolt for 10 db S/N ratio; selectivity adjustable from .6 to 5 kc; operates from 105-125 v, 50/60 cycle ac line.
Special Features: Double conversion superhet; Ferrit if filter with adjustable selectivity; 60:1 planetary tuning drive; S-Meter; provisions for crystal calibrator with front panel corrector; product detector for CW/SSB reception; noise limiter; antenna trimmer and receive-standby switch.
Accessories: XCU-109 Crystal Calibrator. NTS-3 Speaker.
Dimensions: 8 5/8" x 15 5/8" x 9" deep.
Weight: 28 pounds.
Last Amateur Net Price:
NC-155 Receiver...............$199.95.
XCU-109 Xtal Calibrator........$ 20.95.
NTS-3 Speaker.................$ 19.95.
Current Used Price:
NC-155 Receiver...............$149.00.

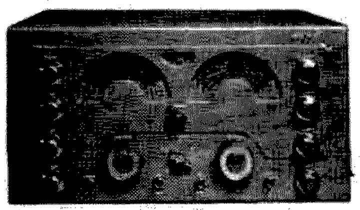
National NC-173



1947-1949

Frequency Coverage: .54 to 31.0 and 48.0 to 56.0 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4.3 mc. (3) 4.3 to 12.0 mc. (4) 12.0 to 31.0 mc. (5) 48.0 to 56.0 mc.
Specifications: 11 tubes plus regulator and rectifier; 500 ohm average antenna input impedance, balanced or unbalanced; 455 kc if; 8 or 500 ohm audio output impedance; draws 83 watts from 110-120 or 220-240 v, 50/60 cycle ac line.
Special Features: 6 position crystal filter; S-Meter; noise limiter; phono jack; tone control; antenna trimmer; receive-standby switch and external power socket.
Last Amateur Net Price: $179.50.
Current Used Price: $109.00.

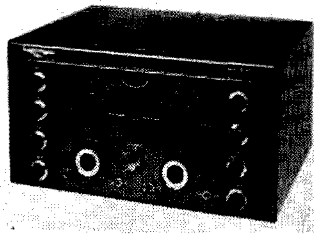
National NC-183



1947-1952

Frequency Coverage: .54 to 31.0 mc and 48.0 to 56.0 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4.3 mc. (3) 4.3 to 12.0 mc. (4) 12.0 to 31.0 mc. (5) 48.0 to 56.0 mc.
Specifications: 14 tubes plus regulator and rectifier; 300 ohm nominal, balanced or unbalanced antenna input; 455 kc if; 8 watts audio output into 8 or 500 ohm load; draws 125 watts from 110-120 or 220-240 v, 50/60 cycle line.
Special Features: Calibrated electrical bandspread; S-Meter; tone control; crystal filter; noise limiter; phono jack; antenna trimmer and accessory/external power socket.
Last Amateur Net Price: NC-183 Receiver complete with speaker.............$269.00.
Current Used Price: NC-183 Receiver with speaker.........................$139.00.

National NC-183D



1952-1958

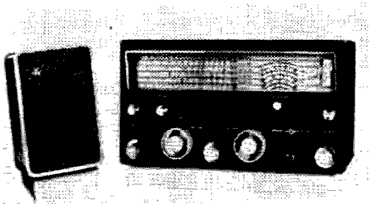
Frequency Coverage: .54 to 31.0 mc and 48.0 to 56.0 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4.4 mc. (3) 4.4 to 12.0 mc. (4) 12.0 to 31.0 mc. (5) 48.0 to 56.0 mc.
Specifications: Updated version of the NC-183 with the following additional features: Dual conversion on bands 3, 4, and 5; new crystal filter with front panel control; new noise limiter and improved sensitivity.
Last Amateur Net Price: $449.00.
Current Used Price: $210.00.

National NC-188

1957-1960

Frequency Coverage: .54 to 40 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4.7 mc. (3) 4.7 to 15 mc. (4) 14.0 to 40.0 mc.
Specifications: 8 tubes plus rectifier; 50-300 ohm, balanced or unblanced antenna input; sensitivity of better than 2.5 microvolts for 10 db S/N ratio; selectivity of 5.2 kc at 6 db down and 22 kc at 60 db down; 1.5 watts audio output into external speaker.
Special Features: Calibrated electrical bandspread; S-Meter; noise limiter; tone control; antenna trimmer and receive-standby switch.
Accessories: NTS-1 Speaker.
Dimensions: 10" x 16 13/16" x 10 7/8" deep.
Shipping Weight: 35 pounds.
Last Amateur Net Price:
NC-188 Receiver..............$159.95.
NTS-1 Speaker................$ 17.50.
Current Used Price:
NC-188 Receiver..............$ 98.00.
NTS-1 Speaker................$ 10.00.

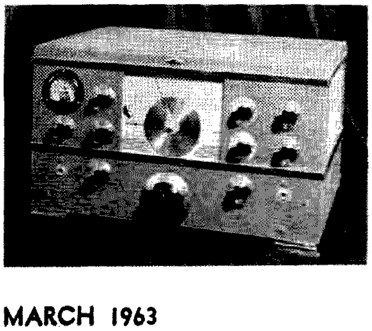
National NC-190

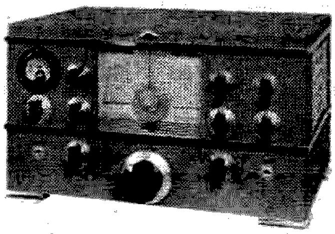


1961-Still Marketed.

Frequency Coverage: .54 to 30 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4.0 mc. (3) 4.0 to 10.0 mc. (4) 10.0 to 20.0 mc. (5) 20.0 to 30.0 mc.
Specifications: 8 tubes plus rectifier and régulator; coaxial antenna input; 230 and 2215 kc if; 1 watt at 10% distortion audio output to 3.2 ohm load; sensitivity of better than 1 microvolt for 10 db S/N ratio; selectivity adjustable from .6 to 5 kc; operates from 105-125 v, 50/60 cycle ac line.
Special Features: Double conversion superhet; Ferrite if filter with adjustable selectivity; 60:1 planetary tuning drive; S-Meter; calibrated electrical bandspread on amateur and short wave broadcast bands; provisions for crystal calibrator with front panel corrector; productor for CW/SSB reception; noise limiter; antenna trimmer and receive-standby switch.
Accessories: XCU-109 Crystal Calibrator. NTS-3 Speaker.
Dimensions: 8 5/8" x 15 5/8" x 9" deep.
Weight: 28 pounds.
Last Amateur Net Price:
NC-190 Receiver..............$219.95.
XCU-109 Crystal Calibrator.....$ 20.95.
NTS-3 Speaker.................$ 19.95.
Current Used Price: NC-190 Receiver with XCU-109 Crystal Calibrator.....$175.00.

National NC-240C, CS & D





NC-240C: 1946-1949
NC-240D: 1947-1949

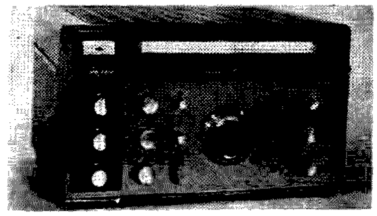
Frequency Coverage, NC-240C: .49 to 30.0 mc; (1) .49 to 1.0 mc. (2) 1.0 to 2.0 mc. (3) 1.7 to 4.0 mc. (4) 3.5 to 7.3 mc. (5) 7.0 to 14.4 mc. (6) 14.0 to 30.0 mc.
NC-240D: Sames as NC-240C except 4 additional bandspread ranges for 10, 20, 40 and 80 meters.
NC-240CS: 200 to 400 kc and 1 mc to 30 mc; (1) 200 to 400 kc. (2) 1.0 to 2.0 mc. (3) 1.7 to 4.0 mc. (4) 3.5 to 7.3 mc. (5) 7.0 to 14.4 mc. (6) 14.0 to 30.0 mc.
Specifications: 11 tubes plus rectifier; 500 ohm balanced or unbalanced antenna input; 455 kc if; 8 watts audio output to external 10,000 ohm plate to plate output transformer for NC-240C, internal transformer with 8 and 500 ohm output windings for NC-240 CS; selectivity adjustable from .2 to 7.5 kc at 6 db down and from 2.0 to 21.5 kc at 60 db down; requires 110-120 or 220-240 v, 50/60 cycle ac power.
Special Features: Calibrated amateur band bandspread on NC-240D; crystal filter; noise limiter; S-Meter; tone control; phono jack; accessory/external power socket.
Last Amateur Net Price: $375.00.
Current Used Price: $100.00.

National NC-270

1960-Still Marketed.

Frequency Coverage: (1) 3.5 to 4.0 mc. (2) 7.0 to 7.3 mc. (3) 14.0 to 14.4 mc. (4) 21.0 to 21.5 mc. (5) 28.0 to 29.7 mc. (6) 50.0 to 54.0 mc.
Specifications: 8 tubes plus regulator and rectifier; 52 ohm unbianced antenna input; 230 and 2445 kc if; 1.5 watts audio output at 10% distortion to external 3.2 ohm speaker; sensitivity of better than 1 microvolt for 10 db S/N ratio; LSB and USB selectivity of 3 kc at 6 db down and 12 kc at 40 db down; AM/CW selectivity adjustable from slightly less than 1 kc to slightly less than 6 kc at 6 db down to 6 to 17 kc at 40 db down; draws 75 watts from 105-125 v, 50/60 cycle ac line.
Special Features: Double conversion superhet with adjustable bandwidth and selectable sideband; product detector for SSB reception; T-Notch filter; noise limiter; S-Meter; antenna trimmer; crystal calibrator with front panel corrector; crystal controlled 2nd converter oscillator; receive-standby switch.
Accessories: NTS-3 Speaker.
Dimensions: 8 5/8" x 15 5/8" x 9" deep.
Weight: 28 pounds.
Last Amateur Net Price:
NC-270 Receiver..............$279.95.
NTS-3 Speaker................$ 19.95.
Current Used Price:
NC-270 Receiver..............$185.00.
NTS-3-Speaker................$ 10.00.

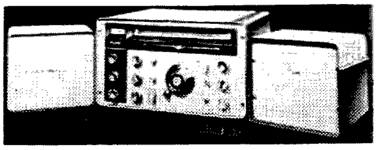
National NC-300



1955-1958

Frequency Coverage: (1) 1.8 to 2.0 mc. (2) 3.5 to 4.0 mc. (3) 7.0 to 7.3 mc. (4) 14.0 to 14.4 mc. (5) 21.0 to 21.5 mc. (6) 26.5 to 27.5 mc. (7) 28.0 to 29.7 mc. Following bandswitch positions and calibrated scales provided for accessory converters: (8) 49.5 to 54.5 mc. (9) 143.5 to 148.5. (10) 220.0 to 225.0 mc.
Specifications: 10 tubes plus filament regulator, voltage regulator and rectifier; 50-300 ohms antenna input impedance; 80 and 2215 kc if; 1 watt audio output into external 8 ohm speaker; noise figure of 4 db on 20 meters and 5 db on 10 meters; selectivity of .5, 3.5 and 8 kc at 6 db down; draws 60 watts from 110-120 v, 60 cycle ac line.
Special Features: Double conversion superhet; optional crystal calibrator; crystal filter; separate product detector for SSB reception; noise limiter; tone control; S-Meter; phono jack; separate rf and if gain controls; calibration corrector; accessory converter switching using 30 to 35 mc tunable if; muting terminals and accessory socket with af input, if output and rf gain points brought out.
Accessories:
NC-300TS Speaker.
XCU-300 Crystal Calibrator.
NC-300CC Converter Cabinet.
NC-300 C1 220-225 mc Converter.
NC-300 C2 143.5-148.5 mc Converter.
NC-300 C6A 49.5-54.5 mc Converter.
Dimensions: 11 1/4" x 19 1/4" x 15" deep.
Shipping Weight: 60 pounds.
Last Amateur Net Price:
NC-300 Receiver..................$349.95.
NC-300TS Speaker................$ 19.95.
Current Used Price:
NC-300 Receiver..................$215.00.
NC-300TS Speaker................$ 10.00.

National NC-303

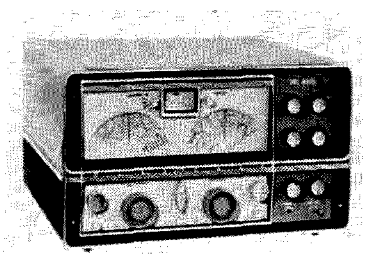


1958-Still Marketed.

Frequency Coverage: (1) 1.8 to 2.0 mc. (2) 3.5 to 4.0 mc. (3) 7.0 to 7.3 mc. (4) 14.0 to 14.4 mc. (5) 21.0 to 21.5 mc. (6) 26.5 to 27.5 mc. (7) 28.0 to 29.7 mc. Following bandswitch positions and calibrated scales provided for accessory converters using 30 to 35 mc, tunable if input: (8) 49.5 to 54.5 mc. (9) 143.5 to 148.5 mc. (10) 220.0 to 225.0 mc.
Specifications: 12 tubes plus current regulator, voltage regulator and rectifier; 80 and 2215 kc if; sensitivity of better than 1 microvolt for 10 db S/N ratio; selectivity of .4, 2.0, 3.5 and 8.0 kc at 6 db down; operates from 110-120 v, 50/60 cycle ac line.
Special Features: Double conversion superhet with selectable sideband; separate product detector and noise limiter for SSB reception; automatic noise limiter for AM reception; crystal controlled 2nd converter oscillator; fast attack, slow release AGC for SSB/CW; Q-Multiplier; tone control; provisions for optional crystal calibrator with front panel corrector and WWV reception; S-Meter; muting terminals with provisions for accessory converter switching; muting and provision for control of rf gain during transmission.
Accessories:
NTS-2 Speaker.

XCU-303 Crystal Calibrator and WWV ceiver Converter.
NC-303 Converter Cabinet.
NC-300C1 1 1/4 Meter Converter.
NC-300C2 2 Meter Converter.
NC-300C6A 6 Meter Converter.
Dimensions: 11 1/4" x 19 1/2" x 15" deep.
Weight: 64 pounds.
Last Amateur Net Price:
NC-303 Receiver................$449.00.
NTS-2 Speaker.................$ 19.95.
Current Used Price:
NC-303 Receiver................$235.00.
NTS-2 Speaker.................$ 10.00.

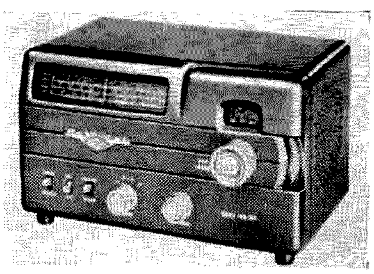
National NC-400



1959-Still Marketed.

Frequency Coverage: .54 to 31.0 mc; (1) .54 to 1.1 mc. (2) 1.1 to 2.1 mc. (3) 2.1 to 4.1 mc. (4) 4.1 to 7.0 mc. (5) 6.9 to 12.2 mc. (6) 11.8 to 20.4 mc. (70 19.6 to 31.0 mc.
Specifications: 16 tubes plus regulator and rectifier; 455 and 2175 kc if; sensitivity of less than 1 microvolt for 10 db S/N ratio; frequency stability of .002% after warm-up; requires 110 or 220 v, 50/60 cycle ac power.
Special Features: Double conversion superhet above 7 mc; manual tuning with option of using internal or external crystals for all oscillators; 5 crystal sockets provided for fixed channel operation; selectable sideband if system with adjustable selectivity and crystal filter which may be removed to install up to 3 mechanical filters; product detector for SSB reception; fast attack, slow decay AGC for SSB reception; amplified S-Meter; automatic noise limiter for AM, manual noise limiter for CW/SSB; optional crystal calibrator with front panel corrector; tone control; antenna trimmer; if, detector and AGC outputs terminated on rear of chassis for use with external loads of combiners.
Accessories:
NTS-2 Speaker.
XCU-400 Crystal Calibrator.
NC-400 DMK Diversity Modification Kit.
NC-400 FH Mechanical Filter Housing.
MX-400 40 Channel Crystal Adaptor.
Dimensions: 11 1/4" x 19 1/2" x 16" deep.
Shipping Weight: 72 pounds.
Last Amateur Net Price:
NC-400 Receiver.................$895.00.
NTS-2 Speaker...................$ 21.95.
Current Used Price:
NC-400 Receiver: $500.00. Price varies widely.
NTS-2 Speaker: $10.00.

National SW-54



1951-1958

Frequency Coverage: .54 to 30.0 mc; (1) .54 to 1.6 mc. (2) 1.6 to 4.7 mc. (3) 4.6 to 14.5 mc. (4) 12.0 to 30.0 mc.
Specifications: 4 tubes plus rectifier; 455 kc if; 1.8 watts audio output into internal speaker; selectivity of 3.4 kc at 6 db down and 49.5 kc at 60 db down with 100 microvolts input; draws 25 watts from 105-130 v, 50/60 cycle ac or dc line.
Special Features: Internal speaker; receive-standby switch and speakerphone switch.
Last Amateur Net Price: $59.95.
Current Used Price: $30.00.

RME 45

1946-?

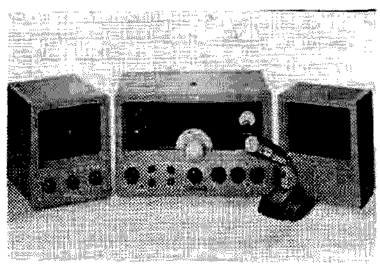
Frequency Coverage: .54 to 33.0 mc; (1) .54 to 1.6 mc. (2) 1.6 to 2.9 mc. (3) 2.9 to 5.4 mc. (4) 5.4 to 9.8 mc. (5) 9.8 to 18.0 mc. (6) 18.0 to 33.0 mc.
Specifications: 8 tubes plus regulator and rectifier; balanced or unbalanced antenna input; 455 kc if; 4/6 ohm audio output; operates from 115 v, 60 cycle ac line.
Special Features: Calibrated mechanical bandspread; crystal filter; tone control; S-Meter; noise limiter and receive-standby-transmit switch.
Last Amateur Net Orice: $198.70.
Current Used Price: $75.00.

RME 84 & 84 A

1946-?

Frequency Coverage: .54 to 44.0 mc; (1) .54 to 1.65 mc. (2) 1.65 to 5.0 mc. (3) 5.0 to 15.0 mc. (4) 15.0 to 44.0 mc.
Specifications: 7 tubes plus rectifier; balanced or unbalanced, 300 ohm antenna input; 455 kc if; audio output of 1.1 watts to internal speaker; draws 62 watts from 117 v, 60 cycle ac line.
Special Features: Internal speaker; mechanical bandspread system; noise limiter; tone control; socket for optional S-Meter; accessory/external power socket and receive-standby switch.
Dimensions: 9 3/8" x 18" x 9 3/4" deep.
Last Amateur Net Price: $98.70.
Current Used Price: $52.00.

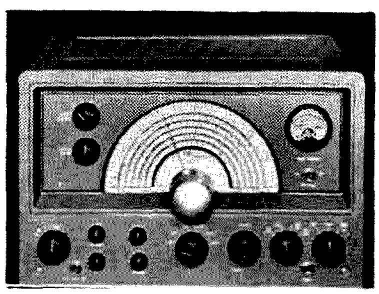
RME 4300



1956-1958

Frequency Coverage: Amateur band coverage, 1.76 to 29.8 mc.
Specifications: 6 tubes plus regulator and rectifier; 455 kc if; 4 ohm audio output; selectivity of 2.8 kc at 6 db down and 14 kc at 60 db down; sensitivity of 2 microvolts for 10 db S/N ratio; operates from 117 v, 50/60 cycle ac line.
Special Features: Crystal filter with adjustable selectivity; dual speed tuning drive; noise limiter; S-Meter; provisions for use with external SSB adaptor; receive-transmit-standby switch.
Dimensions: 10" x 16 1/2" x 10" deep.
Last Amateur Net Price: $194.00.
Current Used Price: $125.00.

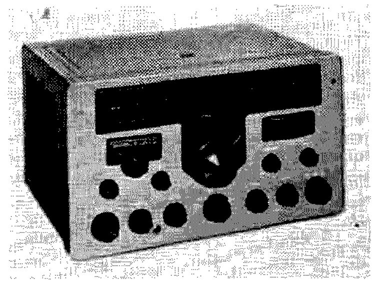
RME 4350



1958-1960

Frequency Coverage: (1) 1.8 to 2.0 mc. (2) 3.5 to 4.0 mc. (3) 7.0 to 7.3 mc. (4) 14.0 to 14.35 mc. (5) 21.0 to 21.5 mc. (6) 26.95 to 29.7 mc.
Specifications: 8 tubes plus regulator and rectifier; balanced or unblanced antenna input; 455 and 2195 kc if frequencies; sensitivity of 2 microvolts for 10 db S/N ratio; audio output of 1.5 watts into external 4 ohm speaker; draws 65 watts from 117 v, 50/60 cycle ac line.
Special Features: Double conversion superhet; dual speed tuning drive; crystal calibrator with front panel corrector; crystal filter with adjustable selectivity; antenna trimmer; noise limiter; S-Meter; provisions for external SSB adaptor; adjustable BFO injection; receive-transmit-standby switch.
Dimensions: 10" x 16 1/2" x 10" deep.
Weight: 32 pounds.
Last Amateur Net Price: $249.00.
Current Used Price: $150.00.

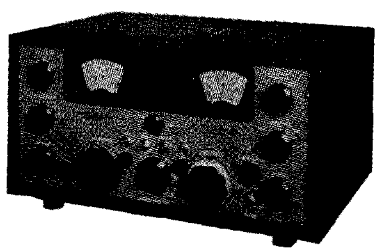
RME 6900



1960-Still Marketed.

Frequency Coverage: (1) 10.0 to 11.0 mc. (2) 3.5 to 4.0 mc. (3) 7.0 to 7.3 mc. (4) 14.0 to 14.4 mc. (5) 21.0 to 21.5 mc. (6) 28.0 to 29.7 mc.
Specifications: 11 tubes plus regulator and 2 silicon diodes; antenna input of 50-400 ohms, balanced or unbalanced; 57 and 2195 kc if frequencies; sensitivity of 1 microvolt for 50 mw audio output at 10 db S/N ratio; adjustable selectivity if .5, 2.0 and 3.6 kc at 8 db down and 3.3, 7.3 and 11 kc at 60 db down; audio output of 1 watt into external 4 and 500 ohm loads; draws 55 watts from 117 v, 50/60 cycle ac line.
Special Features: Dual conversion superhet; crystal controlled 2nd conversion oscillator; T-Notch filter; if noise limiter system; separate SSB detector; internal crystal calibrator with front panel corrector; adjustable BFO injection; antenna trimmer; adjustable delay AGC system; S-Meter; receive-transmit-standby switch.
Dimensions: 9 3/4" x 17" x 12 1/8" deep.
Weight: 35 pounds.
Last Amateur Net Price: $349.00.
Current Used Price: $250.00.

Technical Materiel GPR-90



1956-1959

Frequency Coverage: .54 to 31.0 mc. in six bands.
Specifications: 13 tubes plus rectifier and voltage regulator; 75 ohm unbalanced or 300 ohm balanced antenna input; 4, 8, 16 and 600 ohm audio output impedance; sensitivity 1 microvolt for 10-1 signal to noise power ratio; selectivity variable in 6 steps from 200 cy to 5KC; 105-125vac 50/60 cy., at approx. 90 watts; also 250 vdc @ .01A and 6v. @ 6A.
Special Features: dial locks; noise limiter; calibrated "S" meter.
Dimensions: 20" x 10" x 15" in cabinet; also can be rack mounted.
Weight: 52 pounds.
Last Amateur Net Price: $495.00
Current Used Price: $325.00

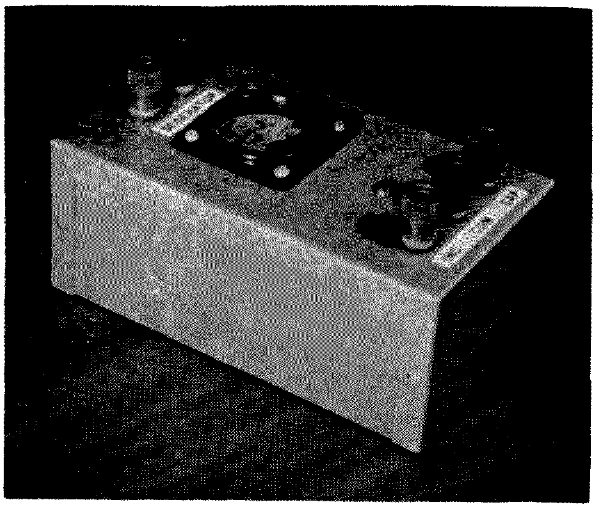


Fig. 1. Completed L-C probe.

Rufus Turner K6AI
122 East Mariposa St.
Altadena, California

Measure L and C

Build this inexpensive probe for simplifying the job. Operated from an audio signal generator, it has a range of 12.6 mmfd to 1260 mfd, and 63.4 uh to 6340 henries.

EVERY SERIOUS TECHNICIAN owns an audio signal generator. This is an extremely useful instrument and, in addition to its many other jobs, it can be used to measure capacitance and inductance. Most such instruments may be tuned from 20 to 200,000 cps, and this will permit L and C measurements over a wide range.

Fig. 3 shows the method. The unknown component is connected with a known component of the opposite sort to form a series-resonant circuit. Thus, for checking capacitance (Fig. 3A), the unknown C is in series with a known inductance; and for checking inductance (Fig. 3B), the unknown L is in series with a known capacitance. The oscillator develops a voltage drop across a low resistance, R, connected in series with L and C, and this voltage excites the circuit. An af milliammeter, M, deflects to a peak when the oscillator is tuned to the resonant frequency of the L-C combination, and this response is sharp if R is low. The frequency then is read from the oscillator dial, and the unknown component is calculated from this frequency f and the known component: $C=0.0253/f^2L$, or $L=0.0253/f^2C$. (C is in farads, L in henries, and f in cycles per second.) A single capacitor and inductor permit measurement of virtually all coils and capacitors, fixed and variable, ordinarily encountered in the field.

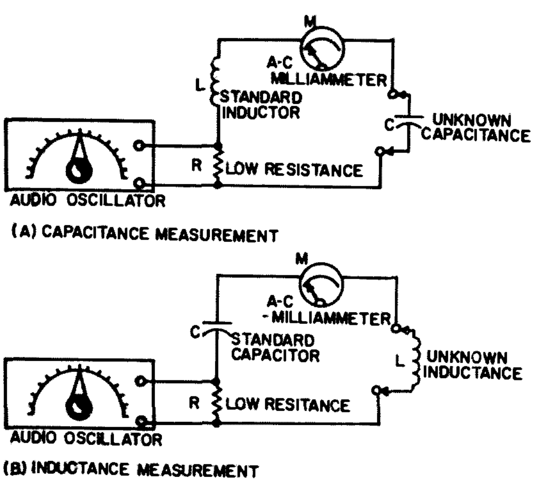


FIGURE 3

Technicians who use this method usually keep on hand an accurate capacitor and inductor but these components are easily mislaid or damaged when loose. The ac milliammeter is not a common instrument in most shops, and the circuit must be assembled each time it is needed. These are nuisances which may be avoided by building a simple, inexpensive L-C probe which is always on hand to be connected to the oscillator when needed and in which the standard capacitor and inductor are protected. Figs. 1, 2, and 4 show details of this probe.

Probe Description

Fig. 4 shows the complete circuit of the

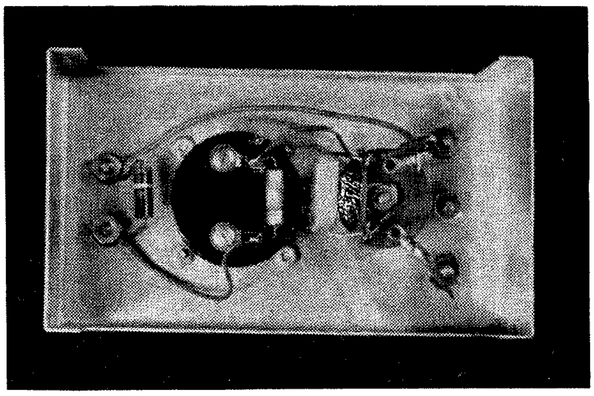


Fig. 2. Inside view of the probe. Notice the simple direct wiring and the few components needed.

probe. Here, the standard inductor, L, is a 50-millihenry rf choke and the standard capacitor, C, is an 0.01-mfd silvered mica capacitor. The af milliammeter consists of a 1-inch 0-50 dc microammeter, M, shunted by a 1N34 germanium diode, D. The oscillator is connected to terminals 1 and 2, and develops the signal voltage across a 47-ohm carbon resistor, R. An unknown capacitor is connected to terminals 3 and 4, or an unknown inductor (coil) to terminals 4 and 5. (This arrangement obviates the need for function switches.) The signal-voltage level is controlled by adjusting the output control of the audio oscillator and is between 0.3 and 0.7 volt rms for full-scale deflection of meter M.

The probe is built into an aluminum chassis box, 5¼" long, 3" wide, and 2⅛" high. Fig. 2

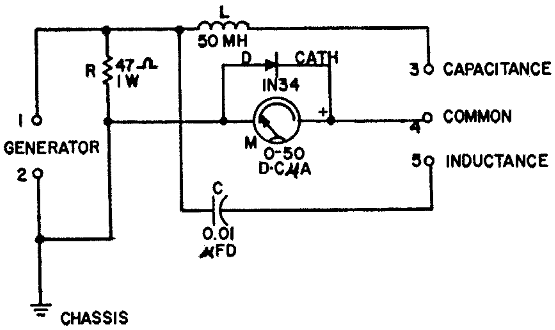


FIGURE 4

C—0.01 mfd silvered mica—Aerovox 1464
D—General-purpose germanium diode—1N34
L—50-mh radio-frequency choke—Miller 918
M—1-inch 0-50 d-c microammeter—Lafayette TM-200
R—47-ohm 1-watt carbon or composition resistor

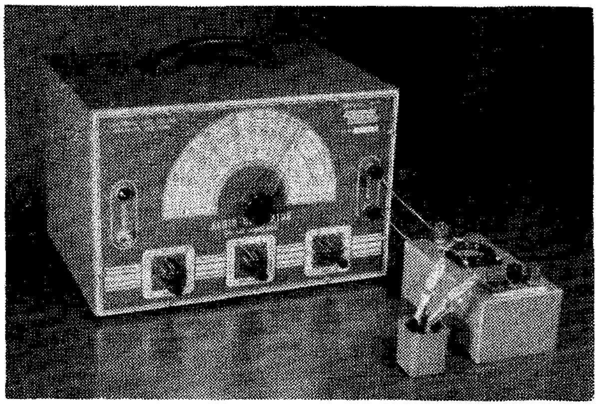


Fig. 5. Test setup with oscillator and probe. Here, a small iron-core inductor is under measurement.

shows internal construction. The only precaution is to keep the wiring away from the chassis and to mount the choke at least ½ inch from the chassis (use a 2-inch-long 6-32 screw).

Standard tolerances in the specified inductor and capacitor insure a measurement accuracy of 5 to 10 percent. But higher precision may be obtained by hand-picking L and C for exact specified values of 50 mh and 0.01 mfd. The measurement range is usefully wide: for capacitance, 12.6 mmfd at 200 kc to 1260 mfd at 20 cps; for inductance, 6340 henries at 20 cps to 63.4 μh at 200 kc.

Operation

To make a measurement (1), connect probe to oscillator. Terminal 2 must be connected to the grounded output terminal of the oscillator. (2) Switch-on oscillator. (3) Connect unknown capacitor to terminals 3 and 4, *or* unknown inductor to terminals 4 and 5, using shortest possibe leads. (4) Tune oscillator for peak deflection of meter. (5) Adjust oscillator

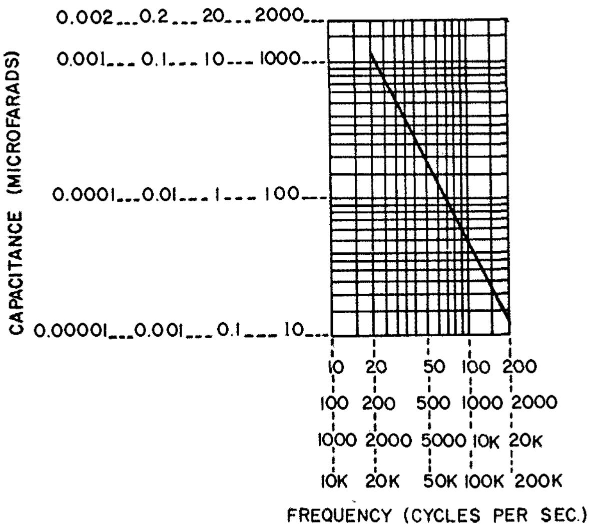


FIGURE 6

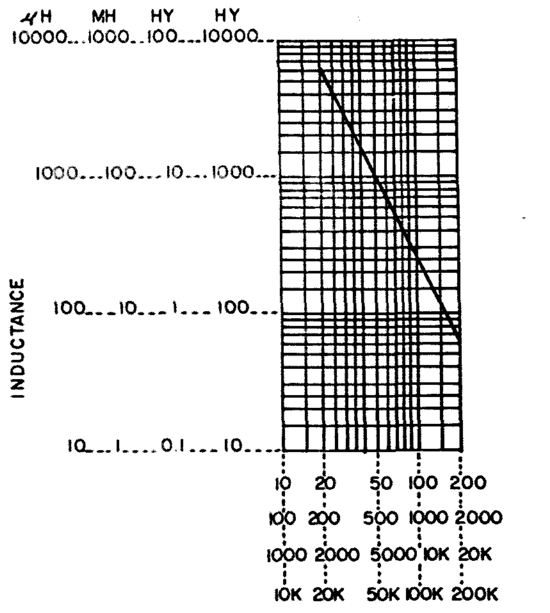


FIGURE 7

output to bring deflection in upper portion of meter scale. (6) Read resonant frequency, f, from oscillator dial. (7) For maximum accuracy, *calculate* $C=506{,}600/f^2$, or $L=2{,}530{,}000/f^2$ (in each case C is in mfd, L in hy, and f in cps).

For faster but somewhat less accurate determination of C or L from frequency, involving no calculations, use one of the following methods:

Charts. Use the Capacitance Chart (Fig. 6) or Inductance Chart (Fig. 7) given in this article.

Reactance Slide Rule. For capacitance, (1) set the slide to the resonant frequency, (2) On the capacitance scale, read the capacitance value that is lined up with 50 mh on the inductance scale. For inductance, (1) set the slide to the resonant frequency. (2) On the inductance scale, read the inductance value that is lined up with 0.01 mfd on the capacitance scale. . . . K6AI

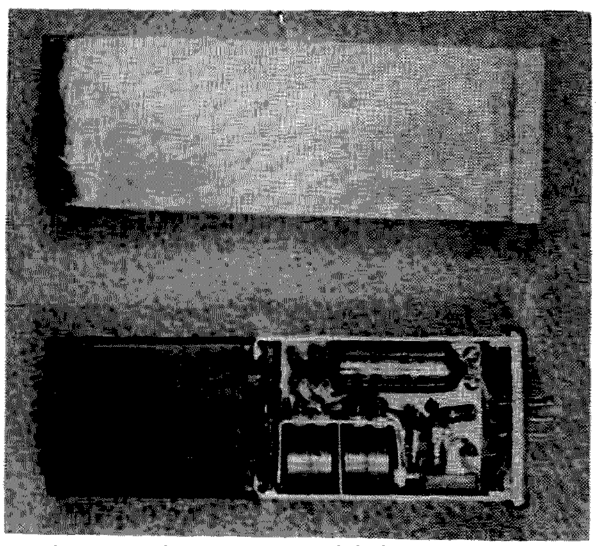
Surplus Crystal Calibrator

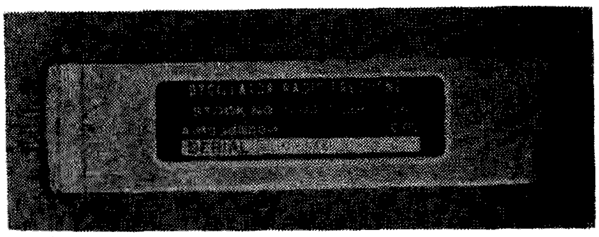
Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Photography by Morgan S. Gassman, Jr.

MILITARY SURPLUS electronic gear falls in the three major categories of end equipments, sub-assemblies and components. As far as the amateur is concerned, the utility of available items in all categories ranges from the so called "boat anchors" to the real bargains.

One particularly desirable sub-assembly is


This view shows the crystal holder-oven at the top of the unit. The pot core inductors and the sub-miniature tube are also visible.


This compact little calibration oscillator plugs into a standard 7 pin tube socket.

the 500 kc crystal calibrator used in the AN/ARC-21 Aircraft Radio Set. This hermetically sealed unit is available in quantity from Barry Electronics[1] and is a real bargain at $3.75 plus postage. As shown in the photographs, the complete calibrator is housed in a compact, nickel plated brass case measuring 4¼" x 1-7/16" x 1⅛". These dimensions are exclusive of the connector which plugs into a standard 7 pin miniatude tube socket.

The circuit, shown in Fig. 1, uses a type 5840 sub-miniature tube. The crystal is housed in an oven-type holder. This oven, which requires a 28 volt ac or dc supply, may or may not be used, depending on the order of stability required. The oscillator requires a 6.3 volt ac or dc heater supply and 75 to 100 volts B+ for the plate and screen supply. With the crystal oven used and with a regulated B+

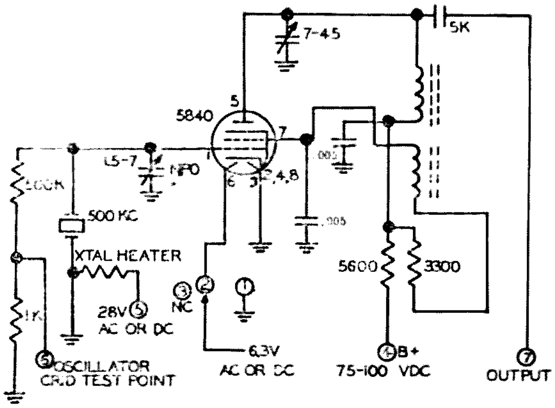


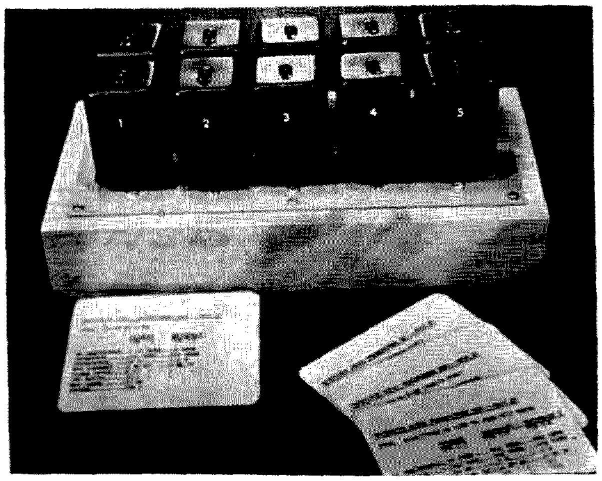
FIG. 1

voltage of 75 volts, stability of the oscillator is ±.0012%. This is fully adequate for most applications.

This unit is ideally suited for use as a receiver calibrator or band edge maker. Simply apply the recommended operating voltages and couple the output to the receiver antenna. An insulated lead connected to Pin 1 of the unit with a couple of turns wrapped around the antenna lead will provide sufficient coupling.

. . . W4WKM

[1]Barry Electronics Corporation, 512 Broadway, New York 12, New York



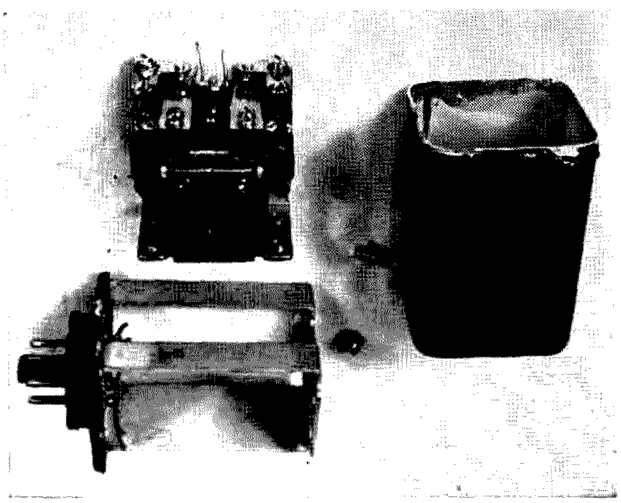
This test transformer set is an example of the use that can be made of surplus relay cans.

Use of Surplus Plug-in Cans in Amateur Construction

Roy E. Pafenberg

Photography: Jim Gardner

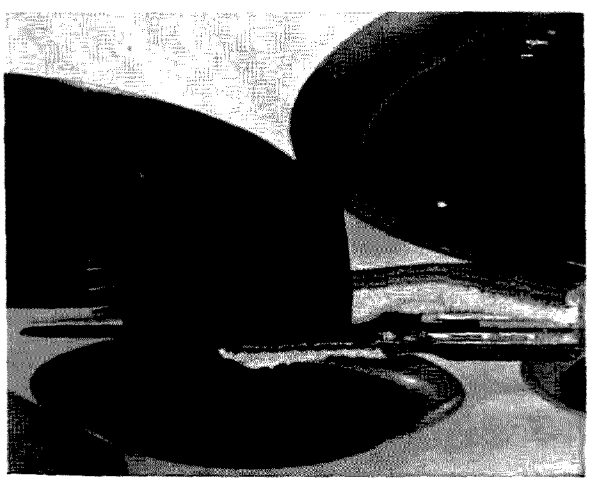
A search of any hams junk box will usually disclose a large number of hermetically sealed, plug-in relays which had been pur-



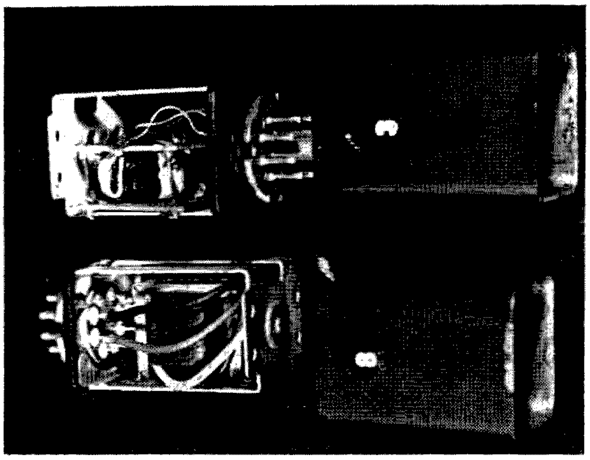
The unusable relays are easily removed from the can, leaving it ready for cleaning and installation of other components.

chased at a time when their highly improbable operating voltage or current requirements were obscured by equally improbably low price tags. The same considerations that led to the use of the pluck-out components in the original equipment apply equally to amateur construction. In addition, use of plug-in sub-assemblies make construction easier and permits changes to be made without destroying the appearance of the finished project.

Surplus relay cans are ideal for many applications and, in addition to the above cited advantages, provide excellent shielding of critical circuits. Unsoldering the hermetically sealed cans with usually available soldering irons is a difficult task. An ordinary electric hot plate or range burner makes a snap of the job. Turn the hot plate to high heat and place the bottom solder seal of the case on the edge of the heating element. Using gloves or hot pads, turn the relay can to insure uniform heating. As soon as the solder flows, pull the assembly apart. Flick the base to remove excess solder. Place the empty cover back on the



An ordinary electric hot plate or range element does an excellent job of opening those hermetically sealed surplus components.



Close-up view of representative assemblies shows possible mounting methods.

hot plate. Paint, if used will scorch off and, when the tin flows smoothly, drop on a hard surface to remove the debris. Remove the relay from the base, clean up the parts and a custom enclosure results. The photographs show the various steps of the procedure and the complete job requires only a few minutes.

The photographs show the method of mounting components in the can and a finished product using this technique. An added bonus is that many relays, once available for adjustment, may be made usable for amateur applications.

Saga of the Bookshop

HAVING JUST MOVED the Radio Bookshop up to our New Hampshire headquarters building, it seemed to me that some of the over 5000 hams who have bought books from Bookshop might be interested in how such a thing came about in the first place and how it was run.

By way of establishing chronology, it was in January 1955 that I left the hi-fi manufacturing business and stepped in as editor of CQ. By mid-1956 the emergencies with CQ were pretty well solved and the magazine was prospering. At that time it struck me that there should be some sort of book service for amateurs which would make it easy for them to buy radio books which would help them learn more about their hobby. I felt that a hamshack was only as good as the reference library in it and that the ready availability of good reference books might be a good thing.

Cowan, CQ's publisher, didn't think that he wanted to get involved in such a thing. I kept after him about it and finally offered to run it myself if CQ would make advertising space available for it. The first ad ran in the May 1957 issue of CQ . . . a half page ad for three books. Three lonely little orders dribbled in. I can imagine how some manufacturers feel when they spend $200 on a half page ad for what they believe is a good product and then they get two or three orders. I knew that continued (Never Say Die) advertising would do the trick so I kept after it.

By the end of 1957 the orders were coming in every day and it was getting to be more than I could handle. My mother had gotten used to filling the orders whenever I went away to conventions so it wasn't difficult to sort of gradually let her take over completely. She really enjoyed the work and she threw herself completely into it. No book was too hard to find for a customer . . . she would spend days calling local publishers and writing the more distant publishers to find an obscure book that a fellow had written in about. Every order had to go out the day it came in or else she would be miserable. She loved getting letters from customers and particularly enjoyed the rather large foreign business that developed.

The day CQ and I got fed up with each other she was distraught . . . what was going to happen to Bookshop? CQ immediately cancelled the ads and I got a distinct impression that they wouldn't even take them for money. I tried to buy space in QST, but they wouldn't accept any ads, even through an advertising agency. Frustration. Bookshop hibernated. Mother fretted.

When I went to work to start 73 she was delighted . . . Bookshop would be alive again. Since she had never taken any of the profits out of the Bookshop bank account I was able to dip into this to help get 73 started. It helped a lot. As 73 got into publication the Bookshop quickly revived and mother was happily submerged in the problems of getting deliveries from publishers, keeping all other necessary supplies on hand, keeping records, and sending out books.

This summer, when we moved 73 to New Hampshire, there was no possibility of bringing Bookshop along for mother was devoting what time she didn't give to her mother, who was in poor shape after a stroke, to running it and it was helping to keep her busy during this time of emotional stress. When her mother died in December this freed my mother and father so they could plan a trip or two, except for the responsibility of Bookshop. It was a painful decision to make, but after five years of running the Bookshop and sending out some 15,000 books, my mother turned the records and shelves of books kept in stock over to me and we have now set up business in our 73 headquarters building in Peterborough. Mother, known to hundreds and hundreds of Bookshop correspondents as Cleo Willson, wants to thank every one of you that have sent in orders to the Bookshop and to let you know that she enjoyed serving you more than she can express.

We'll carry on with the Bookshop. I'll probably be doing a lot of the work now, helped by Virginia. I hope you'll take a good critical look at your reference shelf and think about adding a good book to it every now and then.

. . . wayne

RADIO Bookshop

Peterborough, N. H.

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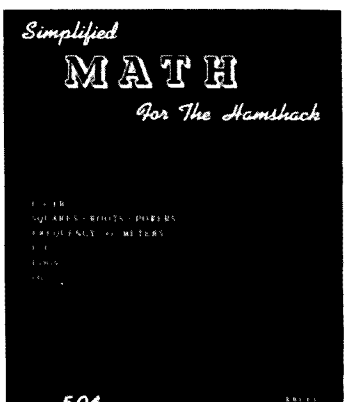

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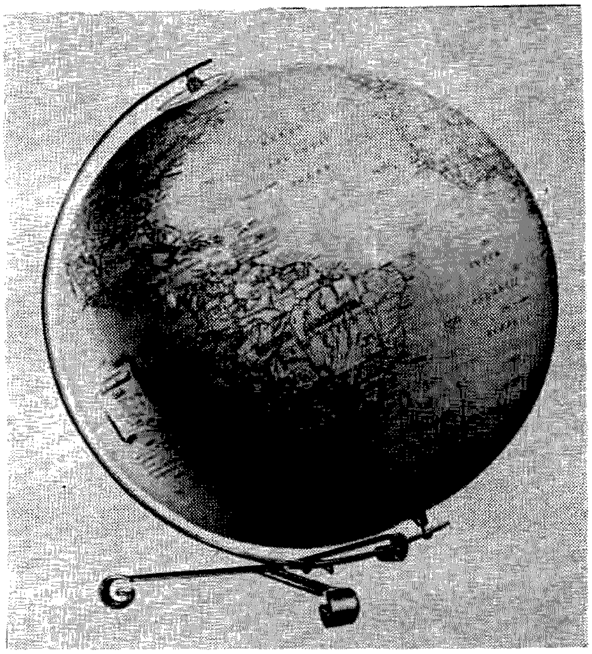
Institute Museum

If you have any ham gear circa the mid or early thirties please make arrangements so it won't be junked when you leave us. We'd sure like to have it for display in the museum here with your QSL on it.

Globe and Subscription: $16.95



If you shop around carefully in other ham magazines you may be able to find this very same globe with no subscription bonus being sold for a paltry $19.95. When you think it over carefully I am sure that you will see their point and order a globe from them for it certainly is worth that three dollars extra not to have another year of 73 to worry about.

In case I have not been as persuasive as usual and you still insist on ordering this terrific 18" diameter (nearly five feet around the equator) world globe and the one year subscription or renewal that goes with it whether you like it or not (unless you are a life subscriber in which case drop us a line for your special deal which I daren't publish for fear of starting a rush for life subscriptions). These plastic balloons are guaranteed, so don't grumble about what happens when it gets old. I have two of them that have been kicking around for over seven years now and they are still going strong. Use them all the time. Deflate 'em when going to hamfests or moving. Just jot your name, address, call, new or renewal sub (give expiration date if you know it), and bundle this up with cash, check or money order (U. S. or Canadian) and send it to us: 73, Peterborough, N. H.

INDEX TO SURPLUS

Here, all in one book, is a list of every piece of surplus equipment that has ever been discussed or converted in a magazine article in any of the radio magazines. The Index lists the equipment, the title, author and issue of magazine where the conversion was published, plus a brief description of the conversion accomplished. Just one single use of this book will be worth several times the **$1.50** price to you. Compiled with painstaking care by Roy Pafenberg W4WKM.

73 Parts Kits

Wayne W2NSD/1

Obviously everyone doesn't have the surplus store size junk box that I have accrued over some twenty plus years in ham radio. To make things easier for the fellow with the restricted junk box we're starting a new service this month: parts kits for our construction projects. From now on, if this idea works out well, we'll have a kit of the basic parts availabe for all of our simpler construction articles. I figure that quantity buying of parts should make it possible to sell parts kits at a little below the regular net prices of the parts (besides the simplicity of getting just exactly the parts required for a project all at once without having to fight your way through several catalogs) and still have it pay for someone to do the purchasing and put the kits together.

These will be kits of parts, not the Heath-type affair with detailed instructions, chassis, etc. Commercial chassis run the prices up on things and greatly complicate packing and shipping, so we'll figure that you will have your own chassis or can make do with an old one, a piece of heavy cardboard, cake pan, etc.

The first of the kits are now available for immediate shipment.

Kit W9DUT-1 Two meter preamplifier $18.50 pp in USA
Kit W6SFM-1 RF Preamplifier 4.00 "
Kit W1MEL-1 QRP Rig 6.00 "
Kit K6LJY-1 Rag Chewer Transmitter 24.50 "
Kit K6LJY-2 Rag Chewer Receiver 16.50 "

Make check out to 73, Inc.

Mail order to 73, Peterborough, N. H.

AMATEUR TELEVISION

A great many fellows are missing out on the fabulous bi-monthly ATV Bulletin edited by Mel Shadbolt WØKYQ. A subscription to this Bulletin is only $1 per year . . . and five issues have already been published. We still have a few back issues available for those that send in immediately. What is in the Bulletin? In addition to news of amateur TV activities all over the country (and elsewhere) there is a directory of all interested hams, a discussion of available surplus and other new or used equipment, etc. To give you a little more detail, here is a list of the features in each of the first five issues:

I UHF Antenna Connector; Source of used Vidicons; Photomultiplier tubes from junk auto dimmers; Linearity test method; ATK with slide projector; 5FP5 tube good for FSS Camera; Test pattern; TV Directory.

II Cheaper Vidicons; ID-66/AXR-1 description, photos, complete schematic, conversion; Converting UHF TV tuners for ATV; That DC Component.

III Slide Camera in a jiffy; 420 mc ATV Antenna; One mc TV proposal; The Camera Lens; Television Standards; Monoscopes; Lecher lines.

IV Twenty pages this time. Image orthicon; Peaking coils; Negative feedback amplifiers; Flying spot scanners; Selection of tubes for video amplifiers.

V Twenty pages again. Complete copy of petition to FCC for ATV experimentation on two and six meters; Gamma; A Monoscope Camera; Don't Be Afraid To Be First; Inexpensive Optics for Flying Spot Scanners; Modification of commercial UHF Converters on the ATV Band; Power supply modification for the Bill Parker Camera; More on the TV Camera; Standardization.

The material in the ATV Bulletins is mostly in the form of articles submitted by interested and active amateurs. Send your dollar right now and don't miss any more issues. Please let us know if you want your subscription to start with the first issue or with the current issue. It might be a good idea to send $2 by now since we have five issues out as this will get you the complete set of back issues plus the next seven issues to come. Don't forget to give your call and address when ordering.

73 Peterborough, N. H.

(W2NSD from page 6)

head is dug into the sand. The ACARN-ARAN-NRRL approach to deficiencies in our own government is about the same . . . when you disagree with governmental actions take matters into your own hands.

Amateur radio represents one of the few mediums for people-to-people communication with the communist world. Few of our magazines are able to get through, few movies, few books. Those few tourists that manage to get behind the iron curtain find themselves hamstrung by the everwatchful Intourist guides and the language barrier. There is no question in my mind that there is a basic struggle going on between communism and democracy and that this is a serious backstage battle. I am indeed unhappy over their victories, many of which seem awfully avoidable. But I think one of the stupidest things we could possibly do would be to cut off the amateur radio contacts with the socialist countries for these contacts cannot do us any harm and can do great harm to them. Time would seem to be in the favor of peace for with every year we find the Soviets moving closer to capitalism and the U. S. moving two steps toward socialism. Will we meet in the middle somewhere or just pass each other going our separate ways.

The NRRL-ACARN proposal to represent the amateurs before Congress, FCC, etc., is the best laugh of all. The FCC regulations do not permit any group to "represent" the amateurs. Under the present setup each amateur represents himself as far as the FCC is concerned and any groups, clubs, etc., are permitted to file comments on the same basis as individual amateurs. I do feel that amateur radio would benefit from some lobby pressure in Washington and have been a bit at odds with the ARRL over their refusal to set anything of this nature up. I think it would be a catastrophe for amateur radio if the NRRL were to step into this void.

All this business got me to thinking about the overall amateur radio setup that we have. The socialistic trend that we have been following of leaning more and more on the Federal Government and doing less and less for ourselves bothers me. We could, through the

ARRL, take over most of the responsibility for our hobby and run it ourselves.

Suppose a Director were elected in each call area whose responsibility was to administer his area. He would receive a salary for his work and would organize the licensing and delicensing in his area. He would then have an assistant in each major radio club who would be in charge of administering license exams and checking out complaints of infractions of the rules. Official Observers would send duplicates of infraction reports to offenders and to the Director. When such reports indicate multiple offenses by an amateur a hearing could be held on the club level and a report of the findings sent to the Director for appropriate action.

At a yearly convention the Directors and all interested amateurs could get together and discuss proposed changes in the regulations and allocations. The Directors could then poll themselves for a final decision on rule changes.

This arrangement would make our hobby a lot more flexible and permit more direct participation in the management by the individual amateurs. It would cut down tremendously on the expense to the FCC for the administration of the amateur program. It would enable us to have supervised exams for all classes of license at no government cost. It would cut down tremendously on the necessity for FCC monitoring of the amateur bands since this would be taken care of by the Official Observers.

Naturally a program like this would increase the costs of running the League, but I think we can well afford a bit higher investment when it would bring us so many benefits. Right now I am paying $15 a year in dues to the Sports Car Club of America, and $12 per year to the Porsche Club of America. I do not figure that either of these are high for the benefits that I get and I would not think $15 a year for the ARRL would be exorbitant if it were to really manage the hobby. This would certainly make generous funds available for the area Director and his administration expenses.

This is all just a thought that occurred to me and I am sure that anyone can poke all sorts of holes in it with little effort. I would rather see ideas to make something like this possible than a list of the reasons why it couldn't work. I'm that way . . . I try to figure out how to do things instead of why they can't be done. Maybe that's why I've been able to successfully start our new little magazine in competition with multimillion dollar

(Turn to page 78)

(W2NSD from page 77)

QST and a large commercial New York publishing house (CQ).

You & Him Fight

The editorial in the February issue of QST didn't upset me much, but it did get me to thinking a bit. Judging from some of the letters I've received this was not a universal reaction. I don't know why people insist on coming to me when they are upset and not thinking, but somehow, in spite of everything I have written to the contrary for the last twelve years, a few fellows have it stuck firmly in their mind that I'm anti-ARRL. Ho, hum.

Briefly, whoever writes the unsigned editorials in QST suggested that we return to the old Class A system of license privileges. This would mean taking away certain phone bands from the General and Conditional Class licensees. The purpose of this is to return to incentive licensing which is supposed to increase the general level of technical knowledge and improve the quality of signals on our bands.

Now I'm for technical knowledge and I'm all for anything that will increase it, but I sure doubt that making a lot of fellows memorize a lot of true-false questions will increase our knowledge much and I'm even more con-

vinced that it will not improve the quality of the commercial equipment being produced so that we will have better signals on the bands. It would, however, make a hundred thousand or so General licensee hams furious, sell a fantastic number of license manuals, and probably trim League membership by aforesaid hundred thousand.

Is this the best way to go about achieving the desired results? If technical knowledge is the goal why try to legislate it when you can encourage it through peaceful means with a series of technical achievement certificates? The Institute plans to eventually do this unless the ARRL steps in and sets up the program first, which would be welcome. It seems to me that my scheme of printing as many simplified technical articles and simple construction projects as I can get written will help steer us all in the right direction.

Much of the QRM on the bands, which I am sure has a lot to do with the whole project (even though it was implicit) could be alleviated by enlisting the cooperation of everyone to become active on more bands and thus spread things out more. It is not that all of our bands are crowded, only that parts of some of them are jammed.

Reciprocation Again

Senator Goldwater has given us a second chance to put our shoulder to the grindstone by reintroducing the bill for permitting the FCC to extend licensing privileges to visiting foreign hams, should they believe it worthwhile. Now, if we could find one single amateur with a few weeks spare time and the perseverance to personally talk this piece of legislation through all of the bureaucracy which is stacked up against it, we might end up with a badly needed change in the old 1934 Communications Act and we might be able to face the foreign amateurs at the next Geneva Conference (on frequency allocations) and find them more friendly. We might also be able to operate from a lot more countries while traveling.

Conventional Conventions

The recent failure of the Hudson Convention to draw more than a handful of amateurs seems to me to be far more than the result of inept planning and bumbling chairmanship. The alibi that the International Communications Fair a few weeks later, so heavily publicized by CQ, drew away amateurs from the Hudson Convention doesn't hold much water when one considers that this too turned out to be a monumental turkey.

What's wrong?

After having attended twenty-odd conventions and participated rather intimately in the staging of one, I think I have some ideas. I am not thinking so much in terms of slight improvements as in basic orientation. All of the suggestions that I made in my November 1961 editorial are still valid and have since been backed up over and over by letters from experienced convention committees, but those ideas aren't basic enough.

What is the purpose of a convention? A long list of purposes can be worked up if you set a committee on the project, but basically it is to get a bunch of hams together and have a good time. OK? And what do conventions offer hams in the way of a good time? Well, they offer a chance to meet other hams and talk. This is fine if you are fairly active and have a group of fellows that you pal around with on the air. In reality it is often difficult to find people to talk to and you usually stick with one or two friends for the whole affair.

There are prizes. I suppose that a few fellows will go to all the trouble to go to a convention, complete with entrance fee, in the hope of winning something great. I have watched too many kilowatt stations being won by the wives of Novices to put much faith in any riches coming my way. With the exception of the Dayton Hamvention most conventions send the great percentage of the conventioneers home empty handed.

There are exhibits. These are popular and are more the crux of conventions than any other facet. The high cost of booths and exhibiting keep down the number of exhibits. Conventioneers spend a great deal of their time at the exhibits, not so much out of interest, but for the lack of anything else to do.

Talks by experts are a feature of most conventions. Some of these are interesting, some are incredibly dull. I've dozed through some interminable talks by top names in our hobby. And some, like the VHF talk by Bruce Kelly W2ICE, stand out for years in my memory.

Something important is lacking. Consider the convention from the aspect of the ham who is trying to decide whether he wants to take a day or two off, spend the $5 entrance fee, and drive all the way to the convention. If he has to foot the bill for the XYL plus hotel then it has to be mighty attractive to him. Even in New York City, where most fellows only have to spend 15¢ plus a short subway ride to attend a convention, more than nine out of ten amateurs stayed home.

Here is my suggestion. Instead of inviting a few well known hams to pontificate, why

not have them conduct seminars for the discussion of all aspects of their specialization. In this way fellows interested in RTTY could get together and talk over new circuits, operating techniques, the solution to mutual problems, etc. The VHF'ers could exchange ideas on allocations, techniques for working and detecting aurora, meteor skip, etc. Group discussions could be conducted on every aspect of our hobby and the attending amateurs could actually participate in the talks rather than having to be just passive listeners, with the privilege of throwing a question or two at the end if there is time.

It seems to me that a lot more enthusiasm for attending conventions might be in evidence if everyone could actively participate like this. I suspect that we would see a lot of fellows carting in their latest homebrew gear to show, their QSL cards to flash, notes on subjects they want to bring up in the various seminars, and a lot of enthusiasm.

Yes, yes, I know . . . there have been seminars at conventions . . . nothing new in the idea. Well, I'm more conservative than liberal, and this means that I am more for the utilization of proven ideas than for the experimentation with untried ones. If our little Institute of Amateur Radio ever grows to the convention stage we'll seminar things to a fare-thee-well (whatever that is).

Quack

The SSBARA will have their usual "Dinner"

(Turn to page 88)

CW Sidetone for SSB Rigs

Shel Shallon K6CYG
11058 Queensland Street
Los Angeles 34, Calif.

MY STORE-BOUGHT SSB rig also does a fine job as a CW transmitter. For CW operation, audio drive to the balanced modulator is disabled, and carrier signal is injected downstream of the balanced modulator. However, the rig does not have a built-in sidetone oscillator as do some of the other rigs on the market. No doubt, the absence of a sidetone oscillator reduced the price of the rig a few dollars from what it might otherwise have been, but the operation convenience is also reduced:

(1) with no sidetone there is no convenient way to monitor my fist when working stations off my own frequency; and

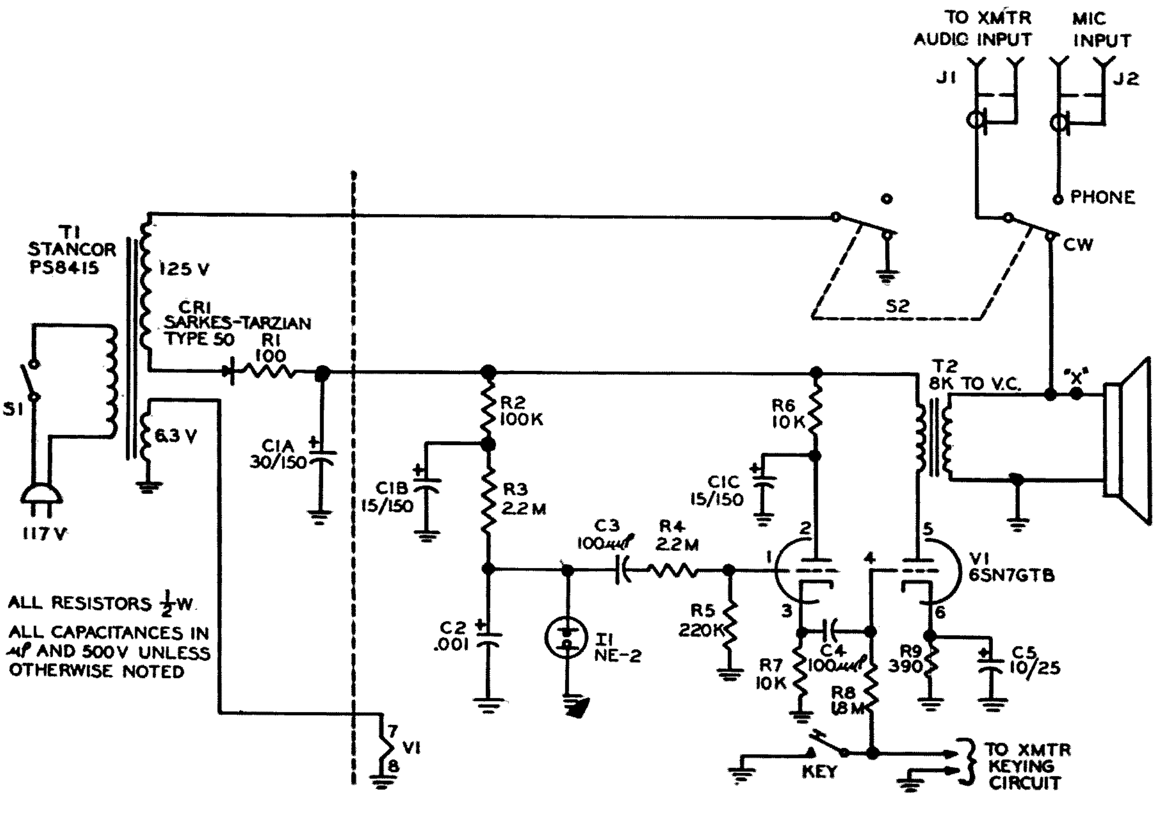
(2) a sidetone audio signal can be used to actuate the transmitter VOX circuit, eliminating the need for a manual send-receive switch.

I decided to add the sidetone oscillator that the manufacturer left out. The resulting unit, built completely from parts in my junkbox, is external to the transmitter and requires absolutely no modification of the transmitter.

The accompanying schematic tells practically the whole story.

The oscillator, consisting of R3, C2, and the NE-2 neon bulb, is about as simple as an oscillator can be. This type of oscillator is especially well suited to this application because the sawtooth waveform that it produces is easier to listen to for extended periods than a sinusoidal waveform. Increasing the value of R3 or C2, or decreasing the supply voltage, will decrease the oscillator frequency; decreasing the value of R3 or C2, or increasing the supply voltage, will increase the oscillator frequency. If you decrease R3 to too low a value, oscillation will stop.

One half of V1 is a cathode-follower; the second half is a keyed audio amplifier with a speaker output transformer as its plate load. The cathode-follower was found necessary to isolate the oscillator from the keying transients at the grid of the amplifier section; without the cathode-follower, the oscillator stopped and



started with each dot and dash.

The two resistors connected to the grid of the cathode-follower comprise an attenuator to set the speaker volume at the desired level. If you want to change the speaker volume, increase or decrease R5, as appropriate.

The bottom end of the amplifier grid resistor, R8, connects to the hot terminal of the key. Your xmtr must use a grid-block keying system in which a negative voltage sufficient to cut off the amplifier portion of V1 exists across the key when the key is open. Closing the key grounds the grid resistor, allowing the tube to amplify; this results in a monitoring tone from the speaker, and actuates the xmtr VOX circuit on the first "dit". The VOX will drop out after the normal delay time when you stop sending.

The power supply is shown to the left of the dashed line in the schematic. I found it more convenient to build in the power supply as part of the sidetone oscillator unit, but you may prefer to steal some current from your rig or receiver, or use another source of power. If you do, plate supply voltages between 90 and 250 volts should work satisfactorily. At 90 volts, the current drain is 6 ma; the current drain will be approximately proportional to the supply voltage. Make certain that the electrolytic capacitors C1B and C1C have sufficient voltage rating to handle whatever supply voltage you use.

The power transformer I used is GE No. K68J661. It comes from a reluctance pickup phono preamplifier. The transformer shown in the schematic is the closest substitute I was able to locate in the catalogs.

There is nothing particularly critical about any of the component values. Cathode by-pass capacitor C5 can have any value from 6 to 25 uf. Resistor values and the values of C3 and C4 can vary 20% from those indicated. The primary impedance of T2 should be between 6000 ohms and 10,000 ohms.

My sidetone oscillator is built on an old chassis (also from the phono preamp) that is not particularly a thing of beauty. Not only is it unworthy of a photograph; but it doesn't even look good in my shack, so I have it mounted under the operating table where it is also out of the way.

One additional note. The zeroing switch on my rig grounds the keying circuit. To avoid sidetone from the speaker when zeroing, I placed a normally-open unused auxiliary contact on my antenna relay in series with the speaker at point "X" on the schematic. This allows sidetone to reach the speaker only when the VOX is activated and the rig is on the air.

. . . K6CYG

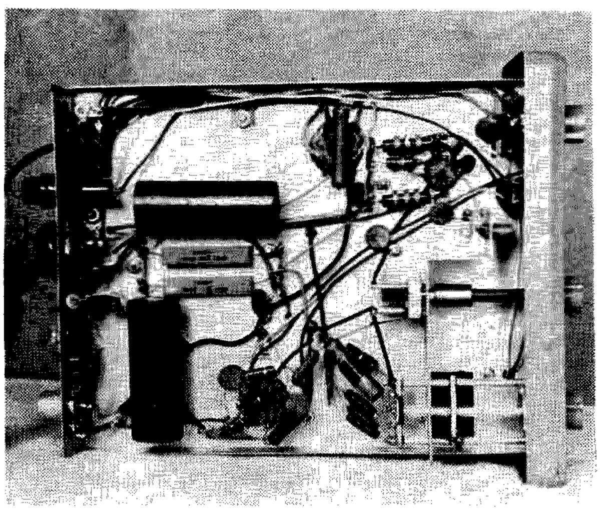
Donald Smith W3UZN
Associate Editor
Kent Mitchell W3WTO

73 Tests the Eico 723

THE EICO PEOPLE have brought out a transmitter which is obviously intended for the Novice, though any amateur would be happy to own it for a standby rig. Economy, ease of construction, and simple operation are among its virtues. Priced at $49.95 in kit form and providing 60 watts CW input on 80, 40, 20, 15 and 10 meters, the rig also has provisions for an external VFO and a modulator when the Novice ticket is exchanged for a General.

The rig has three tubes; a 6CL6 oscillator, a 6DQ6B final amplifier (each of these stages has its own bandswitching plate tank circuit), and a GZ34 rectifier in the power supply. A complete diagram of the 723 is shown in Fig. 1.

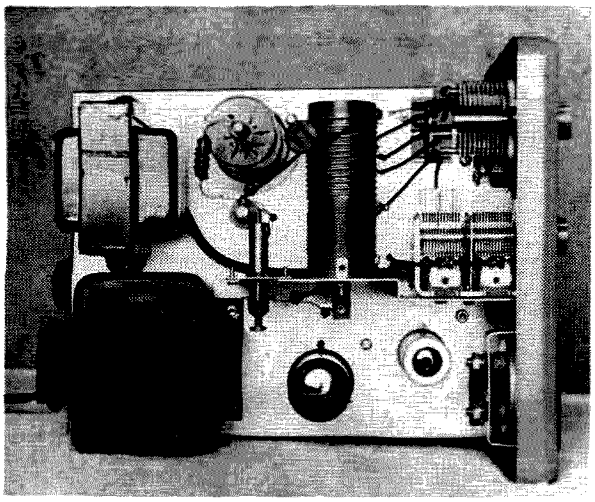
The 6CL6 functions as a Colpitts crystal controlled oscillator. There are two inherent characteristics of this circuit which make it very desirable. First, very little current actually flows through the crystal, thereby reducing the possibility of crystal heating. This greatly reduces any tendency for the crystal to change its resonant frequency. This also eliminates the possibility of the crystal being fractured by excessive current.



Secondly, and most important in a rig of this type, the circuit provides relatively high output at multiples of the crystal frequency and it can be tuned to the desired harmonic by the plate tank circuit. This eliminates the necessity of an additional tube for a buffer-doubler. It also allows the use of 80 meter crystals for 80, 40 and 20 meter operation, while 40 meter crystals may be used on any band, 40 through 10 meters.

Although there is no buffer stage between the oscillator and the final amplifier, frequency shift due to oscillator loading is minimized because the frequency determining portions of the oscillator circuit (the crystal and control grid) are isolated from the oscillator plate tank circuit by the screen grid.

The final amplifier is quite conventional, with the 6DQ6B pentode operating as a class C power amplifier. The final operates straight through on all bands, with the exception of 10 meters, where it functions as a frequency doubler-final. A band-switching pi-network tank circuit serves to match the final to the antenna. Loads of 50 to 1000 ohms may be matched by this circuit. A somewhat unusual feature is an additional 1000 mmfd capacitor



which may be switched in parallel with the 900 mmfd variable used in the pi-network, if proper loading is not possible with a particular type of antenna at the lower frequencies.

Cathode keying is used in the 723, with both the oscillator and the final being keyed. An octal plug on the rear chassis apron permits an external modulator, such as an EICO Model 730, to be placed in series with the final amplifier B+ line. With this arrangement, 50 watts input may be expected on AM phone.

An external VFO may be used by simply plugging its output into the crystal socket on the front panel of the rig. In the event that the VFO does not have a self-contained power supply, Eico has conveniently provided 500 vdc at up to 15 ma and 6.3 vac at the octal socket on the rear chassis apron.

The power supply utilizes a GZ34 rectifier tube, sometimes called a 5AR4, and a 5-25 Henry swinging choke, along with two 40 mfd capacitors. This circuit does a good filtering job and provides good regulation on CW. In the event of ac power failure, the octal plug may be connected to an external emergency power supply, such as a mobile battery operated vibrator supply (see Oct. 1960 issue of 73 Magazine for a delux "Three-way Power

Supply"). Even if the emergency supply does not put out the maximum amount of 500 vdc @ 150 ma, the rig could still be used on an emergency basis at reduced power.

Another feature is that 117 vac is automatically applied to pins 2 and 7 of the rear socket when the Function switch is placed in the "XMIT" position. This voltage can be used to operate an antenna change-over relay and other devices.

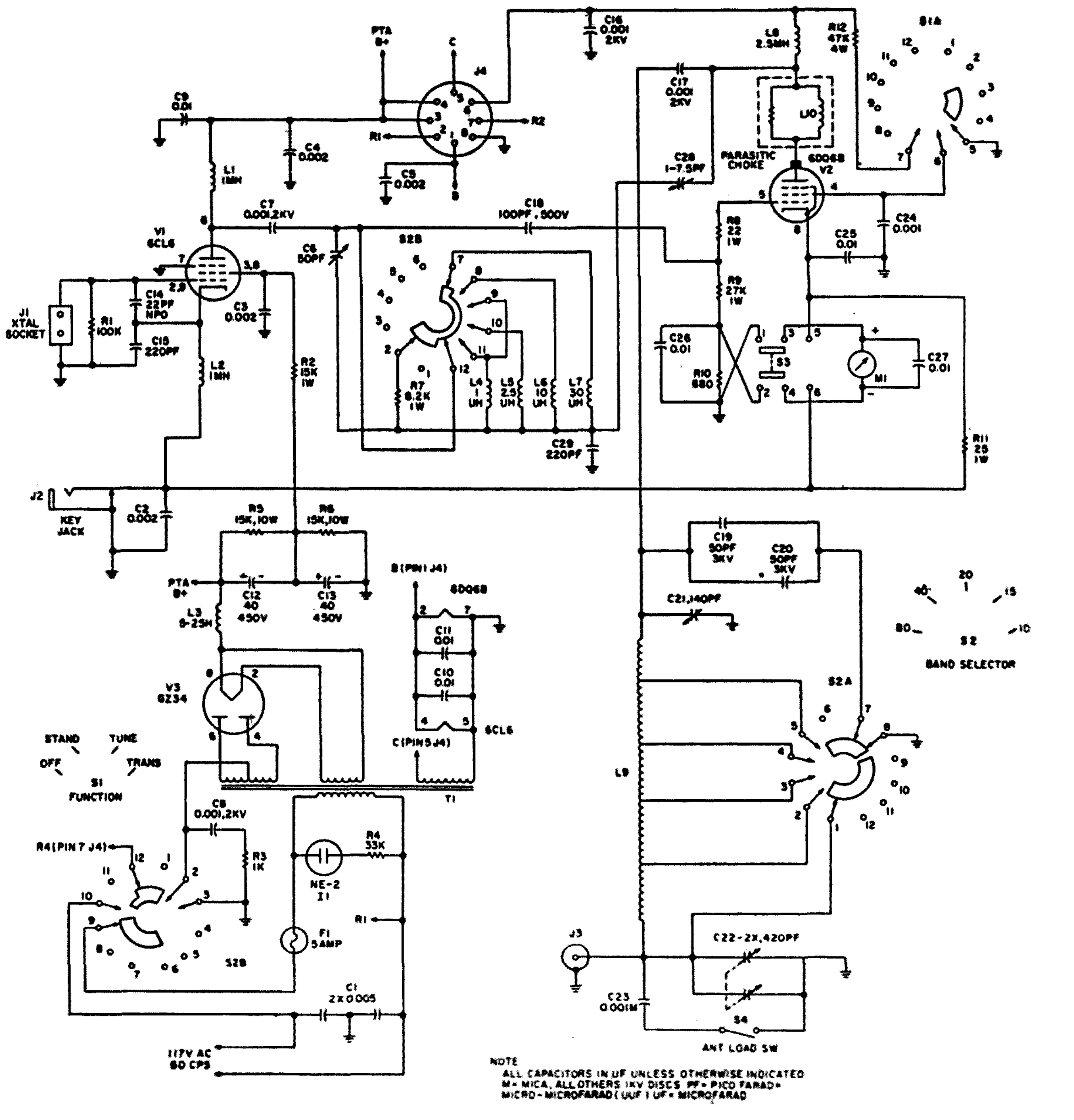
Construction of the kit proceeded without difficulty and no mistakes were found in the instructions. The 160 steps, which sound like a great deal, were easy to follow and were assisted by large, clear fold-outs. Total time required for assembly will run from about 14 to 20 hours, depending on kit building experience. In spite of the relatively small overall size, the under chassis wiring is not at all crowded and should be no problem to someone constructing his first transmitter.

Three amateurs used the rig, each under different conditions and with various types of antennas. Results were as good or better then expected. Most who have used this little rig were surprised at the way it "got out." The cabinet design also is impressive, particularly when you consider the low price. At $49.95 the little 723 is a good buy for the Novice or others who want a good standby rig.

. . . W3UZN-W3WTO

SPEC'S

Power Input: 60 Watts CW; 50 Watts AM-Phone, with external modulator.
Output Load Z: 50-1000 ohms.
Band Coverage: 80, 40, 20, 15 and 10 meter Amateur Bands.
Operation: Crystal control, with provisions for external VFO—Also Plate Mod.
Tubes Used: 6DQ6B final, 6CL6 oscillator, GZ34 rectifier.
Power Requirements: 117 VAC, 60 cy, 140 Watts.
Cabinet Size & Weight: 6" High, 8½" Wide, 11¼" Deep. —15 pounds.
Price: Kit—$49.95
Wired—$79.95



(W2NSD from page 81)

at the Statler-Hilton, an all day hamfest on March 26th. Exhibits, etc. The dinner will run you $12.50 if you order tickets in advance from W2JKN, 4665 Iselin Ave., New York 71. $13.50 at the door. Steak dinner, professional entertainment.

Ritty Eaters

In addition to the other festivities going on at the IRE Show this year there will be the usual gathering of the RTTY clan at the White Turkey Town House, 260 Madison Avenue, New York, at 7 PM, Monday March 25th. The Tab is $6 paid in advance to Elston Swanson W2PEE, Instruments for Industry, 101 New South Road, Hicksville, New York. I'll be there . . . see you.

C W Abbreviations

For many years I've nursed an irritation over the abbreviations used by hams, most of them sponsored by an organization that should know better. I'd like to get my thoughts on the subject over to the gang, through our new and rising magazine 73.

Since 1879 the Phillips Code has been available as a standard of abbreviations suited for the transmission of news over press land-line and radio circuits. Amateurs would do well to adopt this code as a standard of abbreviations. It will make a CW rag chew more enjoyable, and permit a great deal more ground to be covered in a given time. While the code was tailored to news stories, it is ideal for ham usage as well. Let's cite just a few examples: IWU—it was understood; QOH—on the other hand; ENY—enthusiastically; YA – yesterday; YAM – yesterday morning; ELCUD—electrocuted (as some hams are), and it is hoped that they are CBI—covered by insurance, and that their shack isn't DBF—destroyed by fire. There are hundreds more. And the code has an added advantage. It is easier to remember a short abbreviation such as PNPY than to remember how to spell plenipotentiary.

The TCR edition (Telegraph-Cable-Radio) of Phillips Code, is available from the Telegraph and Telephone Age, 25 Beaver Street, New York 4, N. Y. It contains, in addition to the Phillips Code, the various "Q" codes and their commercial equivalent the "Z" codes. In the back of the book are the International and Morse codes, World Time charts, and several foreign alphabets with their code symbols.

After you get your code book, meet me on the air. I used to be a press operator and my speed is a leisurely 55 wpm if your keying is clean and you know how to use your keyer. And, I still remember a good part of Phillips Code. . . . K7MSL

Institute Certificates

CERTIFICATE HATERS CLUB. Available to any licensed amateur who submits a signed statement that he has never been awarded any other certificates and that is, in the future, he is ever awarded another certificate that he will hate it. One dollar required to cover the costs of administration of this program.

WAAS CERTIFICATE. Available to licensed amateurs who submit proof of having contacted 49 states and a dollar to cover the costs of administration of the program. QSL's must be alphabetical by state. Stickers ($1 per application) are available for WAAS made all on any one band or all with one mode of emission (CW-AM-SSB-RTTY).

DXDC CERTIFICATE. DX Decade Club. Available to amateurs who submit proof of contact with any ten official U. N. countries and a dollar to cover costs of administration of the program. Stickers ($1 each) are available for DXDC made all on one band or all with one mode.

RRCC. Real Rag-Chewers Club. Submit signed statement confirming a two-way continuous six hour contact and dollar to cover our costs.

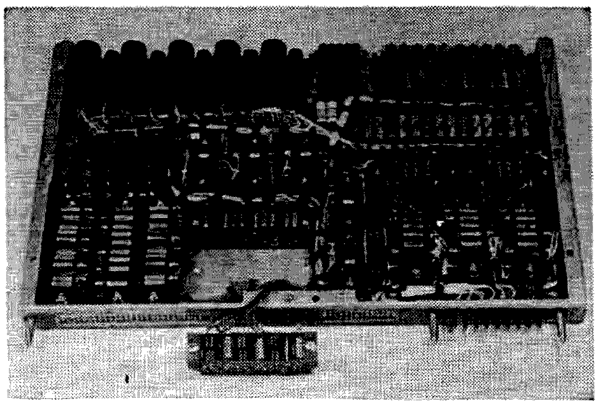
The New Look in Surplus

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

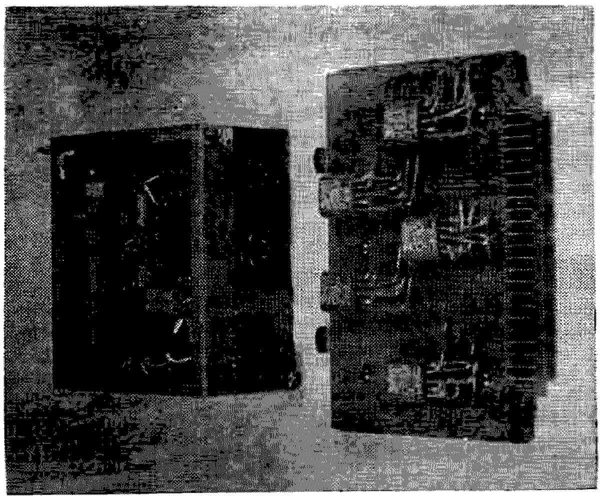
Photo Credit: Morgan S. Gassman, Jr.

"SURPLUS IS DEAD. The only thing left is rusty and mildewed World War II junk which is of no value to anyone." This opinion is heard more and more often these days and nothing could be farther from the truth. Large quantities of military and military quality commercial components are continually entering the surplus market. While no actual figures are available, it is certain that transactions in military and government contract termination, surplus electronic materiel make up a significant portion of the total market volume.

What happens to all of the parts and equipment? Only a very small percentage goes into the amateur surplus market. First of all, listings of surplus materiel are circulated to all government agencies and the military services. Items of use to these activities (this is where your MARS stocks come from) are skimmed off and the balance is eventually put up for bid. Bidders include airline operators, communications companies, exporters, manufacturers, parts distributors, laboratories, R & D organizations, speculators, just plain junk dealers and, finally, your friendly amateur surplus dealer.



Here is a good example of the assemblies selling on the surplus market. This unit, available from RITCO Electronics in limited quantity, is selling for $10.00. The assembly contains thirty 2N332 small signal and ten 2N337 high frequency silicon transistors. At the going rate of $6.20 and $7.80 respectively, net value of the transistors alone is $264.00. Five 10,000 ohm Bourns "TrimPot" potentiometers priced at $8.64 each and five 50,000 units at $9.18 each add $135.00 to the tab. Also included are five 5647 and five 6111 sub-miniature tubes complete with heat sink mounting clips. Over a hundred precision resistors, a good handful of sub-miniature diodes, several glass sealed capacitors and various other parts round out the package.

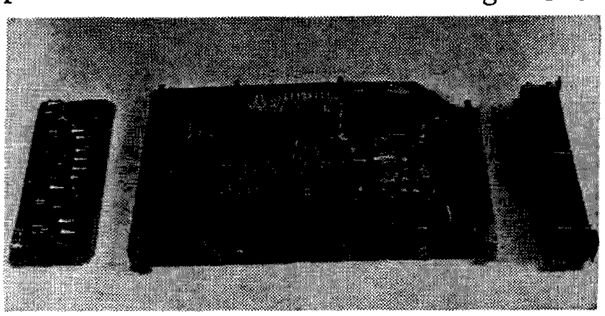


The power supply shown at the left of the photo is typical of the more conventional modern subassemblies available from surplus outlets. This unit contains one 5639 and two 5687WA regulator tubes. Rectifier uses two 1N590 and two 1N591 silicon rectifiers. RITCO charges $8.00 for this one. The right view shows a small relay board. The relays are Potter and Brumfield SL11DM latching units which are selling for more than $15.00 each. Three transistors and numerous diodes are also mounted on the printed circuit board. The complete board is selling for $6.00.

Usable and/or "Type Certified" aircraft electronics and communications equipment finds a ready domestic or export market and this equipment is used for its original design purpose. Modern test equipment also has a ready domestic or export market and, very often, at a price not far from the original cost. Large inventories of components, particularly those of the Mil Spec type, with a history of source inspection, are picked up by the manufacturers and parts distributors.

Now remember that the above transactions are conducted at price levels well above what we amateurs would consider to be in the surplus "bargain" category. It is the residue and overflow that ends up on the shelves of your surplus emporium, priced for sale to the amateur and experimenter market. These stocks are composed of small lots of modern components which can not be economically marketed to the large users, obsolete or older type components, obsolete or non type-approved aircraft communications and electronics equip-

ment, communications and special purpose electronic equipment which has little commercial or industrial use and replacement or repair part assemblies for the above categories of



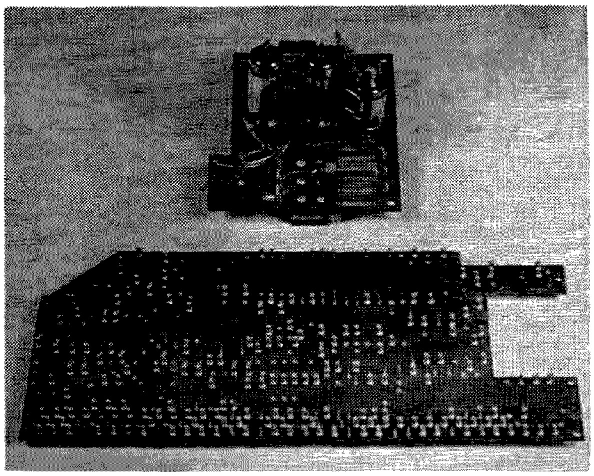
More of the units on hand at RITCO. The video amplifier on the left sells for $6.00. This unit uses six 3N34 high frequency transistors that are currently selling for $17.85 each. The center board contains ten of the previously mentioned 2N332 transistors, one 6021, five 6111 and three 5636 subminiature tubes with heat sink mounting clips. Board also contains a wide variety of other components. Assembly on the right consists of sixty of the "TrimPot" potentiometers and sixty precision fixed resistors.

equipment. Exceptions to the above occur when the quantity of materiel released completely saturates the *world* market so that, regardless of the industrial or commercial applications, the price is pushed down into the amateur bargain category.

Your dealer in surplus electronic materiel probably has all of the above categories of equipment and components in his stocks and he probably sells to most of the markets listed above. Many amateurs have entered into the surplus business with the idea of dealing solely in surplus materiel suited to the amateur and selling solely to the amateur market. Most of these individuals have since diversified their operation or entered into bankruptcy. It is unfortunate, but true, that the amateur market alone will not support such a venture. For the "good deals" on items in heavy demand, yes; but for every good deal there will be one with a hidden kicker or one that turns into a white elephant.

(Turn Page)

The above background information should give you a fair understanding of the facts of life as related to the surplus business. Now, how can you as the bargain hunting amateur turn this knowledge to your advantage? The answer lies in advertising, and conversely, the lack of it. For those items that are widely available in large quantities and which have known application or utility, check your surplus dealer advertisements and compare prices. Then after you have compared price, including any difference in shipping costs, buy from the best source. However, remember that there is an element of risk in any sight-unseen transaction. The major problem area will probably be in the difference between the advertiser's estimate of equipment condition as compared to yours. Of course, the answer to this is inspection before purchase. While this requires a trip to the dealer it can pay off in other ways.



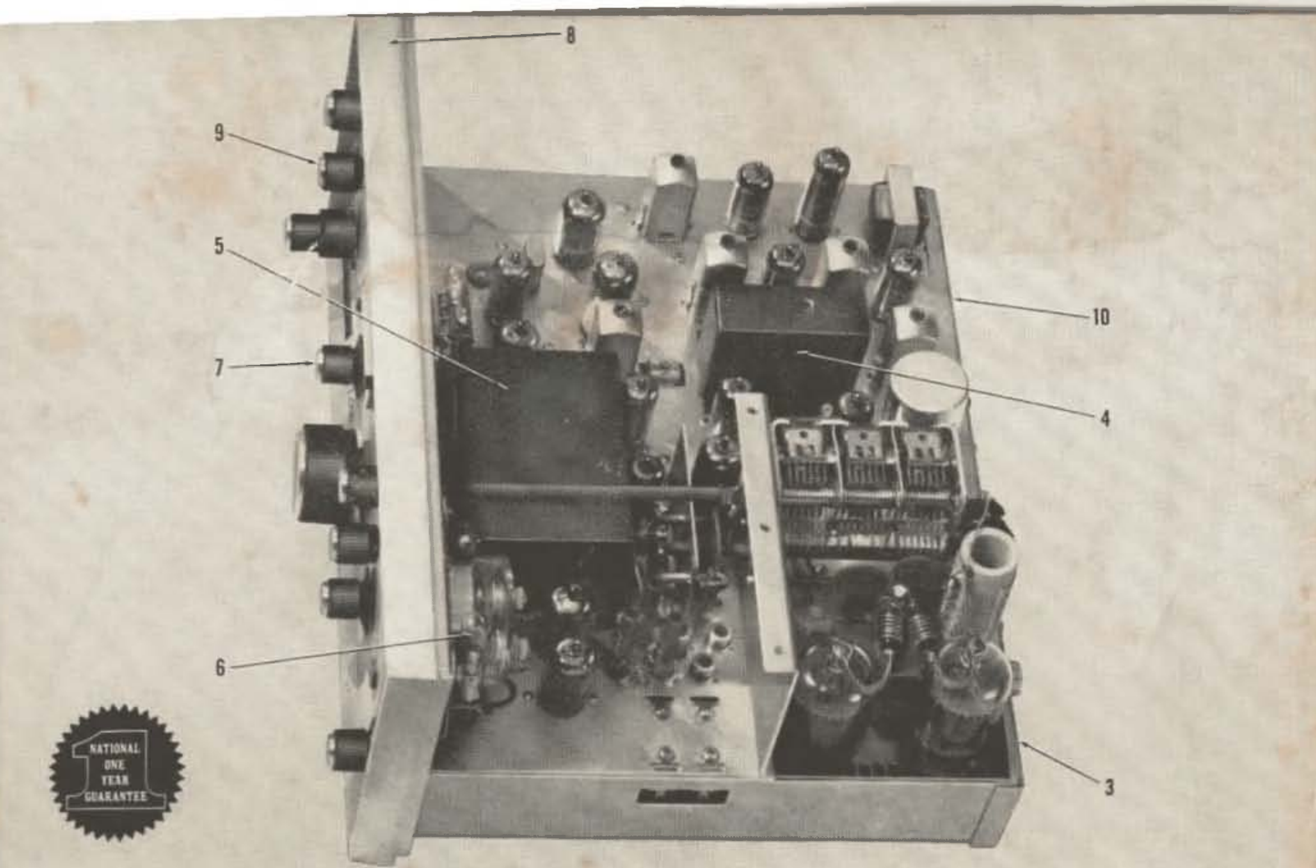
The small regulator-rectifier sub-assembly shown at the top of the photo is selling at around $5.00. The unit contains six 1N1413 high voltage silicon diodes that are currently selling for $20.90 each. The special terminal board shown at the bottom of the photo is typical of the units available on the surplus market. A few minutes with a hacksaw and file will turn out a number of smaller boards to meet your construction requirements.

This brings us to the heart of the matter. If you are interested in acquiring real surplus bargains, visit the dealers regularly. Every dealer has many items of prime components and equipment in quantities too small to advertise individually. Quite often, these bargains will consist of equipments, assemblies, or subassemblies containing the most modern components. Examine these assemblies carefully. With modern packaging techniques, a fantastic quantity of miniature components may be fitted into a small assembly. The acknowledged superiority of these Mil Spec miniature components make them ideal for amateur construction projects.

A visit to RITCO Electronics in Annandale, Virginia proved the case in point. A large variety of surplus sub-assemblies were in stock. Some of these, using the most modern components, are shown in the photographs. Incidently, RITCO was chosen as an example only because of convenience and geographical proximity; all dealers often have items in the same category.

Although the assemblies shown in the photographs are priced within the reach of most amateurs, the value of the components is, from the taxpayer's point of view, rather frightening. To prove the point, a description and component breakdown of each assembly is given in the photo caption. The assemblies presented here are simply examples and the prices shown are for comparison only. Don't go to RITCO, by the time this article appears, and expect to find all these items. They are being sold over the counter, without advertising, only because the quantities of any single item are too small to justify advertising.

The case has been presented. If you have a desire to construct your equipment using the latest techniques and the most modern components, all on a lunch money budget, then visit your surplus dealer. . . . W4WKM



12 inside reasons why your next rig should be the NCX-3 SSB transceiver

1. *Complete* coverage of the 80, 40 and 20 meter phone and CW bands.
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3. Variable pi-network final amplifier uses parallel 6GJ5 pentodes for *conservative* 200 watts PEP on SSB, 200 watts DC input on CW and 100 watts input on AM. Note: Protective shield removed for photo.
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The NCX-3 shown with matching NCXA AC Supply/Speaker Console ($110), is a complete — and compact — 80, 40 and 20 meter amateur station. NCXD Transistorized DC Supply ($119.95) for use in mobile operation. Mobile mounting bracket is included with NCX-3.

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73

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73

Magazine

Wayne Grenee, W2NSD
Editor, etcetera

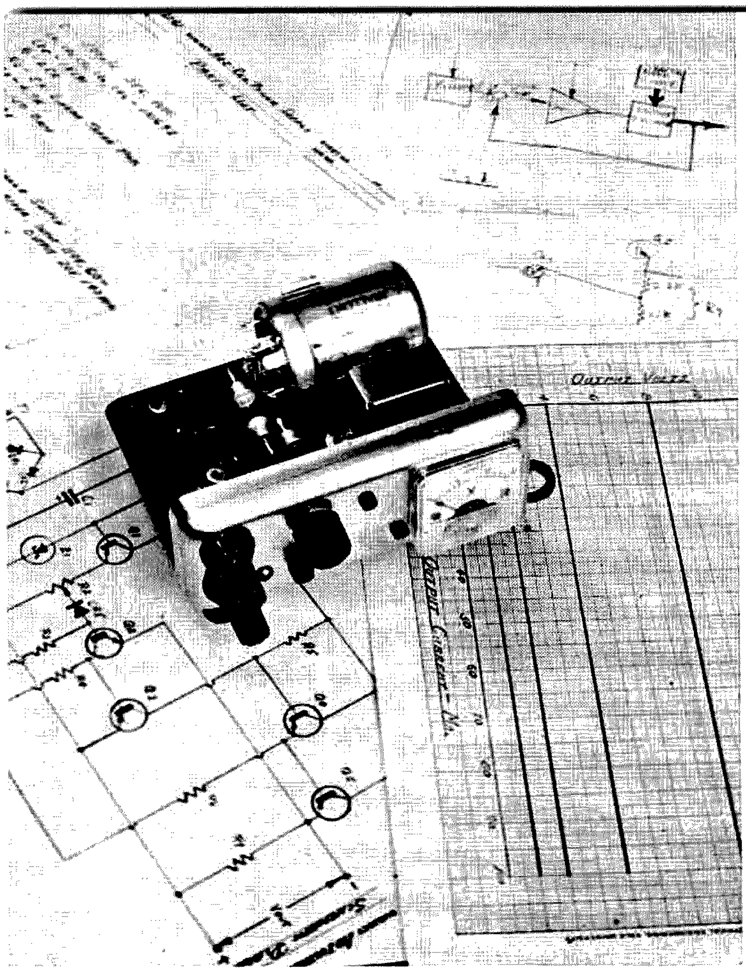
April, 1963

Vol. XIV, No. 4

Cover:
Leonard Tamulonis, W1MEL

73 Magazine is published monthly by 73, Inc., Peterborough, N. H. The phone number is 603-924-3873. Subscription rates are still abysmally low at $3.50 for one year, $6.50 for two years, and $9.00 for three years in North America and U.S. possessions. Foreign subscriptions are $4.00 per year. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in the U.S.A.

Postmaster: please send form 3579 to 73 Magazine, Peterborough, New Hampshire. Readers should stop reading the fine print and stick to the articles and editorial.



This unit is available in a 73 kit because we know that any of you who have been doing any transistor experimenting are probably awfully tired of using batteries by now and know darned well that you have to have one of these.

An Adjustable Regulated Power Supply

Charles Miller W1ISI
General Radio Company
West Concord, Massachusetts

Interest in applying the transistor to both new and older circuit designs has grown at an ever increasing rate in the last few years. Their commercial application has required increasing the quality and the quantity of the output of transistor manufacturers. This has caused the prices of transistors to fall at a rapid rate. This is one vicious circle that has worked to the advantage of the average individual as cost appears to be the major barrier to be surmounted in most construction projects.

One of the problems associated with the design of transistor circuitry is the power supply. That is, most transistor circuits must be operated at low voltages and higher current levels. The average vacuum-tube supply is unsuitable because its output voltage is normally many times higher than the transistors can stand. A vacuum-tube supply may be used with a voltage divider, but this type of supply is useful for only low-level circuits because of the power wasted as heat. Batteries are seldom desirable, owing to their cost and relatively short life, and because their voltage is not adjustable. The usual "cheap and dirty" solution is to use a low-voltage transformer with silicon rectifiers and a simple capacitor-output filter, then use a voltage divider or a simple series power transistor to provide adjustment. These solutions have the disadvantage that even though adjustable, the output voltage will fluctuate with changes in load current and line voltage.

General Considerations

The design of a transistor supply, the output of which is both adjustable and regulated, presents many problems.

Fig. 1 is an elementary diagram illustrating the "series-regulator" technique. It is applicable to both transistor and vacuum-tube power supplies. The unregulated supply consists of an ideal voltage source V_S with an associated internal resistance R_i. The load R_L is connected to the supply through the series resistance R_S. It may be seen that all components are shown to be variable except R_i. This allows us to consider:

a) the adjustment of the value of V_O.

b) the effects on V_O as R_L (and thus I_L) varies.

c) the effect on V_O as V_U varies.

Since from Ohm's Law

$$V_O = I_L R_L \quad (1)$$

and

$$I_L = \frac{V_U}{R_L + R_S}, \quad (2)$$

$$V_O = V_U \frac{R_L}{R_L + R_S}. \quad (3)$$

Thus if V_U is assumed constant for the moment, the value of V_O for a given value of R_L is determined by the value of R_S. Under these conditions then, V_O depends only on the setting of R_S. If R_S is zero (short circuit), equation 3 becomes

$$V_O = V_U \frac{R_L}{R_L + 0} = V_U \quad (4)$$

and

If R_S equals infinity (open circuit), then

$$V_O = V_U \frac{R_L}{R_L + \infty} = 0 \quad (5)$$

Referring again to equation (3), if the value of R_L is changed with V_U and R_S constant, V_O will change. However, a new value for R_S may be found such that

$$\left(\frac{R_L}{(R_L + R_S)_1}\right) = \left(\frac{R_L}{(R_L + R_S)_2}\right) \quad (6)$$

leaving V_O unchanged.

Variation of V_S is due essentially to fluctuations of the line voltage into the supply. For a fixed load, from equation (1), V_O can be constant only if I_L is constant. But

$$I_L = \frac{V_S}{R_L + R_S + R_i} \quad (7)$$

Thus R_S must be varied as V_S varies to maintain I_L constant.

Although each phase of the circuit operation was taken individually, complications arise in a practical supply. Of particular importance are the three "corners" of the region of operation indicated in Fig. 2. At low voltage and low current, for example, R_S must be a virtual open circuit. At high voltage and high current, however, its resistance must be extremely low, as the indicated I_L must drop only the voltage *between* the V_U and V_O curves at that point. Perhaps the point of greatest importance though is the condition of low V_O and large I_L. This is the point at which the voltage across and the current through R_S is maximum. Since

$$P = (E_{R_S})\ (I_L) \quad (8)$$

R_S thus dissipates a maximum amount of power in the form of heat. As the function of R_S is to be performed by a transistor, the ability of the transistor to satisfy the indicated criteria must be carefully considered.

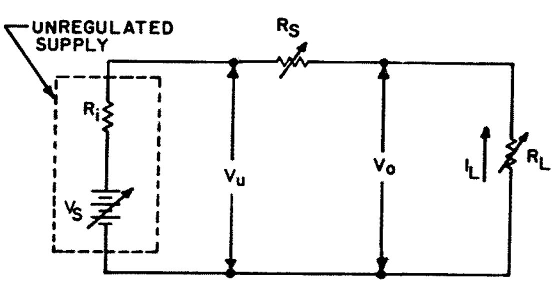


FIG. 1

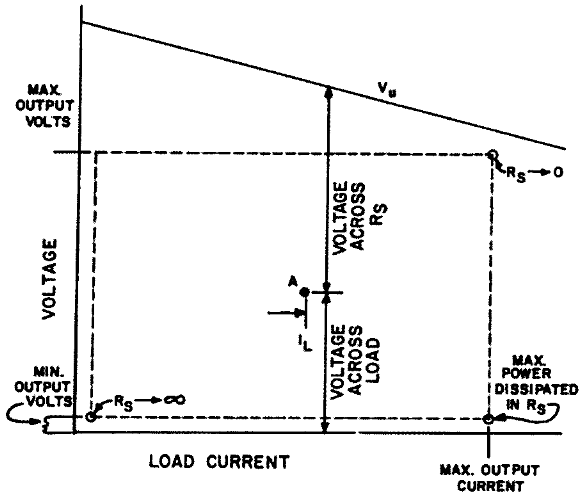


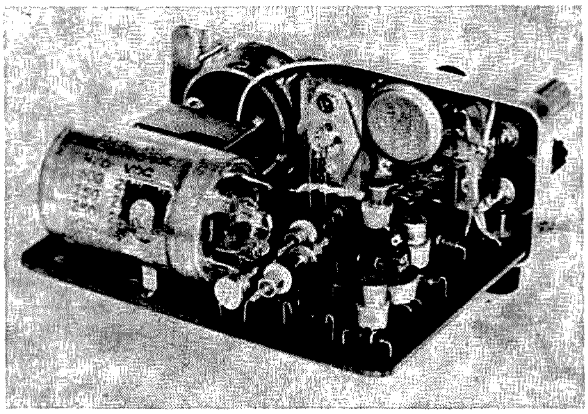
FIG. 2

Operating Conditions
Symbols refer to Fig. 1.
Operating Region of the Supply. Any value of voltage or current within the rectangle may be obtained. Note that the drop across the series element R_S is the difference between Vo and Vu at any output current, as at point a.

It was felt that a lower voltage limit of zero would be desirable. However, experience has shown that in general the minimum supply voltage required in circuit development may be as high as one volt. The maximum supply voltage required is normally 10 to 30 volts. Current requirements for low-level circuits are quite moderate, normally being a few milliamperes per stage.

Circuit Description

We have to this point ignored the method by which the value of R_S is set. A block diagram of the power supply is shown in Fig. 3. The unregulated voltage is applied to an emitter-follower stage. This transistor acts as variable resistor R_S in series with the power supply and R_L and maintains the output voltage at (approximately) the voltage ON ITS BASE. The out-



put voltage is fed back to the summing point. A reference voltage is also applied to the summing point and compared to the output voltage. If the output voltage is not the same as the reference voltage, a difference, or error voltage appears at the input of the amplifier. The error voltage is amplified and applied to the base of the emitter-follower with such polarity as to cause the output voltage to approach a level equal to the reference-voltage level. This should immediately be recognized as a negative-feedback amplifier with the reference source acting as the input signal.

The summing point may be treated either as a voltage or as a current summation. Unfortunately, current summing at the amplifier input requires the reference and output voltages be of opposite polarity so that in equilibrium, the sum of the currents into (or out of) the amplifier-input terminal equals zero. There are some definite advantages to be gained by this technique, but a second power supply is required. Voltage summing is employed as it requires no extra supply. As an added advantage, the voltage-summing circuit employed provides some gain for the error voltage in addition to that provided by the amplifier.

The amplifier is necessarily a dc amplifier, and as such, is subject to drift. This condition is made worse by the fact that high gain is

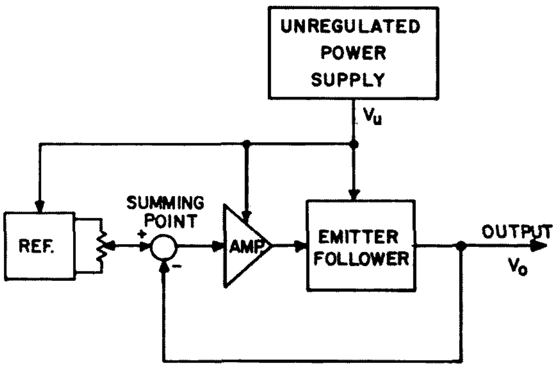
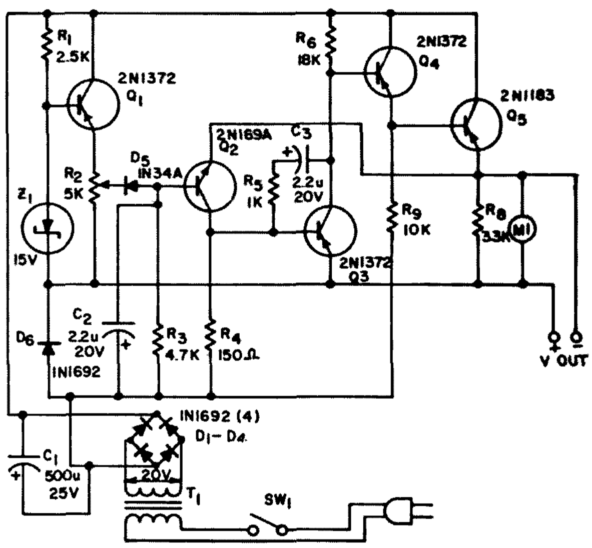


FIG. 3

necessary for good regulation of the output voltage as load current changes. The amplifier is stabilized by large amounts of feedback. Simply stated, although the amplifier has a large gain, the ratio of the output-to-input voltage is one. The only point not stabilized by the dc feedback is at the input of the summing point, and this has been stabilized by an additional compensating circuit. Ac feedback is employed to maintain stability and regulation with capacitive loads and during load transients.

The circuit diagram appears in Fig. 4. An unregulated power supply is formed by T1, CR1-CR4, and CI. The rectifiers form a bridge circuit to full-wave rectify the transformer secondary voltage. With this circuit full ad-

FIG. 4



vantage is taken of the transformer secondary and no center tap is required. The value of CI is large enough to remove most of the ripple. It will be noted that its value is smaller than that normally associated with low-voltage/high-current supplies. Remember that the output voltage is tied closely to the value of the *reference*. Thus, if the reference-voltage ripple is low, the output ripple will also be low. If the power supply is poorly filtered and contains appreciable ripple but the regulator output does not, the regulator has *electronically* removed a great deal of the ripple, just as if a huge capacitor had been employed for filtering. C1 may be thought to have been electronically multiplied by the regulator circuit, in this case to a minimum value of about 50,000 μf.

The reference source is composed of R1 and Z1. If a maximum degree of regulation is desired, with voltage summing, the reference voltage must be as large as the highest output

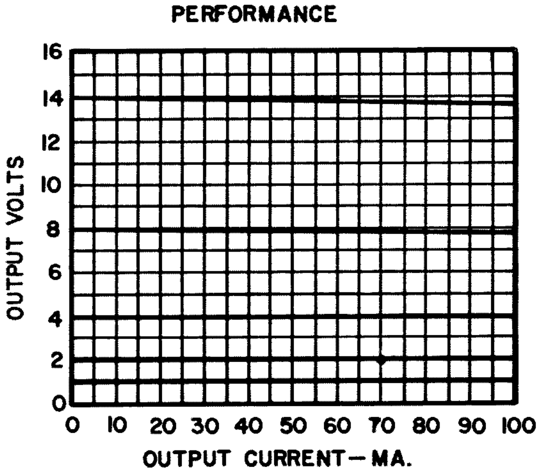


FIG. 5

voltage desired (remember the 1/1 ratio!). The use of a zener diode holds the voltage at the base of Q1 constant. An emitter-follower stage, consisting of Q1 and R2 maintains a constant-voltage output almost equal to that of Z1 across the potentiometer R2, the output-voltage control. Summation is accomplished by Q2. This circuit is novel in that it has no vacuum-tube equivalent. That is, it employs a transistor of polarity opposite to that of all the other transistors in the circuit. This allows the reference voltage as tapped off by R2 to be applied to the base and the output voltage to be applied to the emitter. Any difference between the two voltages is an error signal which is amplified in the collector circuit and applied to the base of Q3, a grounded-emitter circuit. The signal developed across the collector load resistor, R6, is directly coupled to the base of Q4.

The inclusion of R7 assures the ability to adjust the output voltage to the lowest possible minimum value. The actual regulation is the function of Q5. A minimum load, or "bleed" is provided by R8. Drift of the output voltage, which would be caused by changes in temperature of Q2 by altering the base-to-emitter voltage drop, are compensated for by CR5 and R3. Diode CR5 is forward-biased by R3, but its small forward drop is in opposition to the V_{be} of Q2. As the temperature of CR5 and Q2 is raised, both forward drops increase by approximately the same amount, and the voltage between the output and reference remains constant. Returning R3, R4, and R7 to a point slightly more positive than the positive output terminal also helps reduce the lowest minimum output voltage obtainable. The use of a silicon rectifier at CR6 operated in the forward-biased condition provides a small but constant voltage for this purpose. In a sense, it is an economical low-voltage zener diode.

The noise on the output is reduced by the additional filtering of the reference voltage by C2. As with any feedback amplifier, instability may be a problem. The combination of R5 and C3 stabilize the loop by providing degeneration which increases with frequency, necessary when the supply is used with reactive loads.

Operation

With the components specified this supply will deliver 100 ma continuously from its minimum output voltage of 0.35 volts, to its maximum voltage of 15 volts. Fig. 5 illustrates the output-voltage current curves obtained at various values of V_O. The design of this circuit allows considerable latitude in the choice of components. Transistor Q5 may be a higher or lower powered type, though in any case care must be taken that the supply is not operated in such a manner as to exceed the collector-temperature limitations due to excessive current at low output voltage. Proper heat-sinking is absolutely essential. The choice of types for the other transistors is dictated primarily by the voltage supplied from the unregulated power supply (and proper polarity, of course). It is well to be on the safe side and select types which have collector-to-emitter voltage ratings which are approximately 1.4 times the ac voltage appearing across the secondary of T1. Transistors of higher β should make little improvement in regulation, though lower β units for Q2 and Q3 will degrade the regulation. The detectable changes of V_O are due to changes in the zener voltage. This is due partly to the simple reference circuit employed and partly to the dynamic resistance of the zener diode. The zener voltage of Z1 may have any value lower than that given though the use of a lower reference

(More on page 14)

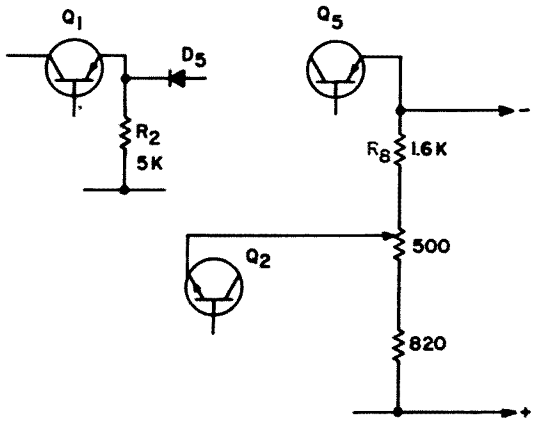


FIG. 6

voltage degrades the regulation somewhat. A diode in the 5- to 6-volt range may be employed to take advantage of the almost zero temperature coefficient. In this case, R8 must form a voltage divider with the emitter of Q2 returned as shown in Fig. 6.

Construction

The photographs illustrate the power supply built by the author. The parts listed on the schematic were selected primarily on the basis of size so that they might be "shoehorned" into an available box. As a consequence, several special parts were made, such as the heat sink for the power transistor. Similar boxes are made by Zero Manufacturing Company, Burbank, California, but construction would be simplified by the use of a larger case. No details of the etched board are shown as each individual will undoubtedly make some parts substitutions. Some of the obvious ones include the use of a heavier power transformer and/or filter capacitor, and a transistor at Q5 capable of dissipating more power. Remember that adequate heat-sinking is of prime importance. No other form of overload protection is provided. If higher output voltage is desired, the technique illustrated in Fig. 6 may be employed, but the secondary voltage of T1 must also be increased. In the event that circuit voltages are changed (and with some transistor substitutions), it will be necessary to alter some of the resistance values in order to assure operation anywhere within a rectangle (output voltage-output current) similar to that shown in Fig. 2.

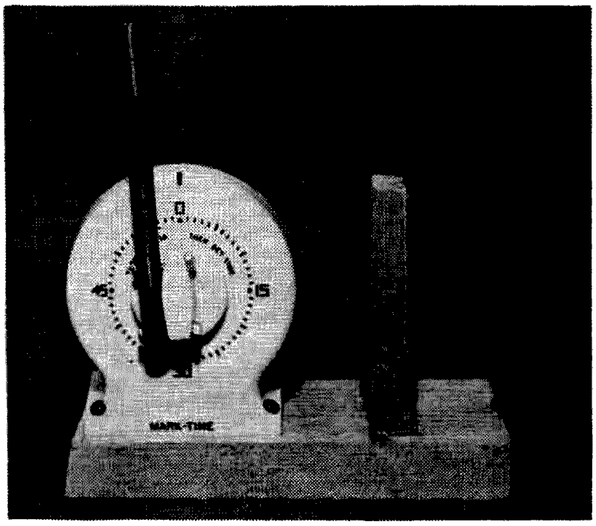
. . . W1ISI

Parts List

C1—500 μfd., 25V Elec.
C2, C3—2.2 μfd., 20V Elec.
CR1, CR2, CR3, CR4, CR6—1N1692
CR5—1N191
R1—2.5K
R2—5K Linear Taper Pot.
R3—4.7K
R4—150 ohm
R5—1K
R6—18K
R7—10K
R8—3.3K
SW1—S.P.S.T. slide switch
T1—Power Transformer, Input 110V, 60Cy
Output 20V, 140 MA
(Magnetic Circuit Elements, Inc.
OB62CT29
Address: 3722 Park Place
Montrose, Calif.
Z1—Zener Diode, 15 V.
Q1, Q3, Q4—2N1372
Q2—2N169A
Q5—2N1183
M1—0-15 VDC Meter (Lafayette TM-100)

Ten Minute Timer

Why not operate legally? Why not keep on the good side of the FCC? Why not buy a ten minute timer for those SSB QSO's? Timers are expensive, so I asked myself (desiring to consult the most astute person on this problem) "Why not build a cheap timer?" The answer to this problem is shown in the photo.



The parts, with the exception of the oven timer (Layfayette Radio $2.95), were found lying on the floor of the shack. The base measures 5½ by 2½ inches and the upright lever stop is 3¼ inches long. The lever itself is a 4 inch piece of aluminum TV antenna element.

When drilling the knob to attach the lever it is best to remove the knob to check that the holes miss the steel leaf spring inside. I found it necessary to pound a small indentation in the lever to make it accommodate the shape of the knob. The lever is attached to the knob with 4-40 screws.

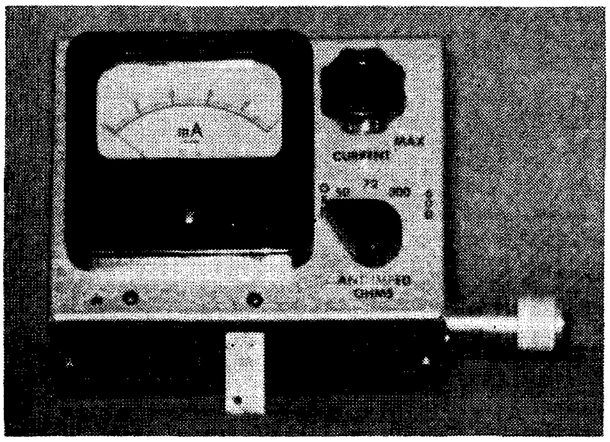
The lever stop is glued to the base approximately 2½ inches from the axis of the knob. It is best to use a slow drying glue since the lever stop will need to be moved back and forth a bit before the exact position for a ten minute run of the timer is found.

. . . W8LWS

Temperature Limited Diode Noise Generator

73 Parts Kit Available . . . see end of article.

F. L. Thomas
7 Park Street
Belleville 9, N. J.



Recently I was confronted with the necessity for a good noise generator. All of the noise generator designs available in any of the amateur publications at hand were of the crystal diode type. The disadvantage of this type of instrument lies in the fact that the current through the diode has no simple relation to the noise output. Unless expensive calibration equipment is on hand this type of generator is useful only on a comparative basis. Consequently it was decided that a temperature limited diode noise generator would be built.

The noise output of a temperature limited diode noise generator is simply related to the current flowing through the diode.[1] The noise figure of a receiver may be calculated directly from the magnitude of the current by the following equation:[2]

Noise figure in db.=10 log (20 I R)−(1)

Where I=current through temperature limited diode required to make the noise output power of the receiver double the value it was with no current through the diode.

R=antenna impedance

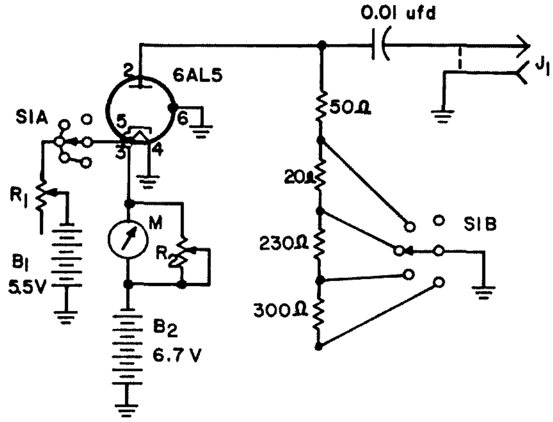
The actual noise generator is quite simple, consisting of half a 6AL5 with a milliammeter in the cathode leg and the appropriate resistance for the antenna circuit connected to the plate by means of a selector switch. The heater current is controlled by a 20 ohm potentiometer in series with the heater. The unit is battery operated for convenience. High current capacity, small sized mercury cells are used throughout. The whole unit is contained in a 3" x 4" x 5" Minibox.

Construction

The resistors are mounted on the switch, making the leads as short as possible. The tube socket is mounted on a small bracket screwed onto the side of the chassis, placed so that the distance from the switch is a minimum. The meter calibration potentiometer and the heater supply battery holders are mounted on another bracket placed over the meter as shown in the photograph.

Operation

To use the generator it is connected to the receiver antenna terminals, the AVC is turned off, and the audio output is measured with the

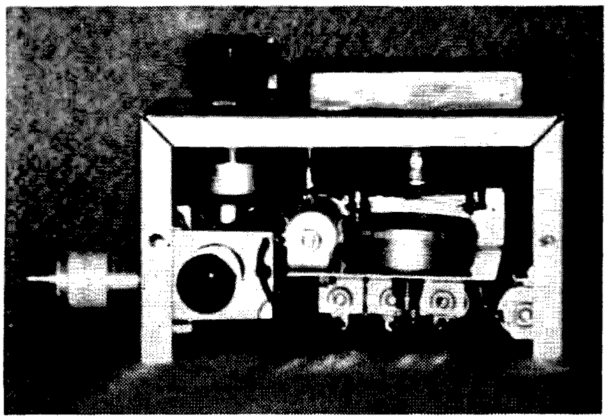


B1—four Mallory RM12 or RM12R in series (lifetime of this circuit should be greater than 10 operating hours)
B2—Mallory TR-135R
M—0-1 ma (Lafayette TM-60 or equivalent)
R1—20 ohm potentiometer
R2—20 ohm Potentiometer
J1—coax connector
S1—DP 5 pos miniature rotary switch

generator off. The generator is then turned on and the current through the diode is increased until the power output is double what it was before. At this point the voltage output will only be 1.41 times the original. The current necessary to give this noise increase is noted and the noise figure calculated according to equation (1), or estimated from the figures given in Table I.

Noise Figure in db.	Current, ma., for antenna impedance of: 50Ω	72Ω	300Ω	600Ω
2	1.40	1.15	-	-
4	2.25	1.80	0.42	-
6	3.55	2.85	-	-
8	5.65	4.50	1.05	0.53
10	8.85	7.15	-	-
12	14.2	11.3	2.65	1.32
16	-	-	6.65	3.30
20	-	-	16.6	8.42

The unit described is useful for noise figures up to 13 db at 72 ohms. For higher noise figures a higher current capacity diode and a higher heater voltage and current supply is required, necessitating an ac operated power supply. With a suitable power supply a 6X4 may be satisfactorily operated up to a noise figure of about 22 db. In both cases the maximum noise is obtained by passing more



than the allowable average current through the diode. Consequently readings at these extremes should be made and the current lowered again in only a few seconds, or damage to the diode will result.

Table I shows the current readings for various noise figures with different antenna impedances.

The generator will operate satisfactorily up to at least 50 mc, and probably considerably higher.

REFERENCES

1. Radiotron Designers Handbook, fourth edition, page 1307, reproduced and distributed by RCA Victor Division, Radio Corporation of America, Harrison, N. J., 1953.
2. Radio Engineering Handbook, fifth edition, page 19-10, Edited by Keith Henney, Published by McGraw-Hill Book Company, 1959.
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Letters

Att. Wayne Green, Editor??

I have been a ham for 36 yrs. and I have never seen any article published as stupid as the one you published by W3PHL. I will not spend any more money for your magazine.

. . . G. V. Lichtenfels W3AQT

Aha, the book-burners rear their ugly heads. While several fellows did write in protesting, none of them quite so obviously had not read the article . . . or even the magazine. The others used our current address and not the one we stopped using over six months ago. Many letters of compliment have come in about this article from the more competent engineers in our readership, and a handful of grumbles have been received, though not one of them took any issue with any part of the article. The complaints against the article seem to be that PHL has a wickedly broad signal on 75 meters and that he has been suspended in the past during a battle with the FCC. I have suffered the judge and jury treatment by the FCC in past years and the mere fact of suspension doesn't necessarily indicate guilt to me any more than Perry Mason considers his clients guilty because they are in prison. We are wide open for more articles on DSB to clarify or confuse matters. I can see some points where PHL missed, though most of the article seems unassailable.

Dear Wayne:

Reference page 86 of the February issue, W7ATK claims there should have been a 2.5 mh rf choke tied to the second plate of his converter rf stage, as illustrated in enclosed, amended diagram. It is true that without one all the intelligence will arc to ground and the pipes will bust, but I draw no conclusions from this or from the other fact that the caption under the "73 Mixer" circuit belongs under a photo of my own dandy converter (omitted). My grandmother always said that simplicity is an unrewarded virtue. She was terpischorean in the grind and bump tradition and at the end of her act she would load her navel with a small marble and pop a balloon at twenty paces. From the collapsed balloon a white dove would fly up into the wings training a satin streamer on which was printed the cryptic comment: "Half the fun is getting there." I believe this has been taken up as a slogan by Cunard. Be that as it may, my grandmother made the bucket one night in Boston for putting out street lights as a result of a wager and soon retired. Please send me whatever certificate is appropriate and enclose a dollar to help cover costs of administration of this program.

. . . Ken W7IDF

Selected Circuits

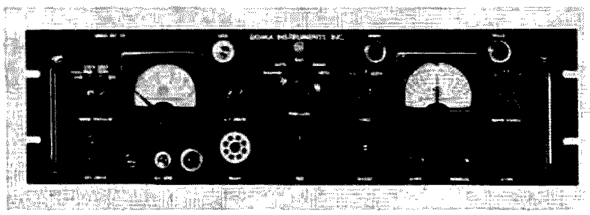
Sigma Series 4500 Polar Relay Test Set

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Polay relays are widely used in teletypewriter applications to provide isolation between various equipments, effect conversion between modes of keying and as repeaters to permit operation of several equipments from a low current signal source. There are very few amateur RTTY installations that do not use one or more of these versatile devices.

The operating requirements imposed on telegraph signalling relays are quite stringent and the present compact, efficient and reliable devices are the result of many decades of development. These relays must accurately repeat the high speed signal impulses without introducing appreciable distortion and must continue to do this on a day in and day out basis.

When we consider that a teletypewriter relay on a 60 word per minute circuit operates several million times per day, the problem becomes apparent. For example, the rated life expectancy of many utility type relays is far less than 1 million operations. Contact materials used in teletypewriter service must be capable of carrying substantial currents and, despite the use of exotic materials, contacts are subject to wear which eventually causes the relay to fail. Since polar relays are expensive, precision devices, the obvious answer is to make them maintainable. Field adjustments are provided and the relays may, *by using proper test equipment,* be easily cleaned and adjusted, restoring their original performance.



Front panel view of the Sigma Series 4500 Polar Relay Test Set.

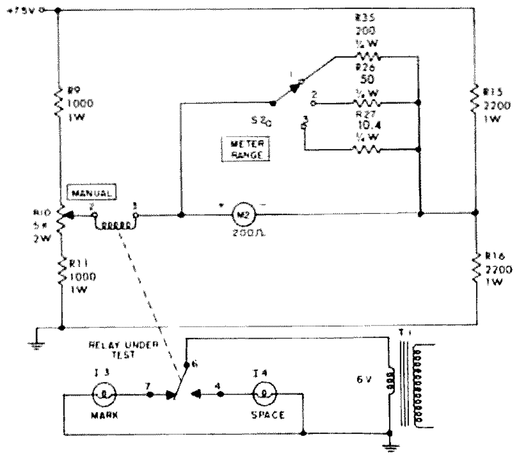


Figure 1: Schematic diagram of the Sigma Series 4500 Relay Test Set MANUAL SENSITIVITY test circuit. Meter multipliers provide ranges of 1.0, 2.5 and 10 MA. Relay terminal numbers refer to Sigma Series 7 and Series 72 relays.
C3 Capacitor, electrolytic, 100 mfd, 110 volt ac.
M2 Milliammeter, dc, .5-0-.5 ma basic range, 200 ohms resistance.

Relay manufacturers who are concerned with long term customer satisfaction must make available maintenance concepts and procedures, repair parts and suitable test equipment for field adjustment of their relays. One of the foremost relay manufacturers, Sigma Instruments, Inc., has done just this in support of their extremely fine Series 72 polar telegraph relay. The Sigma Relay Test Set, Series 4500, is a compact instrument that incorporates test circuits for the rapid, convenient and accurate measurement and adjustment of all the important characteristics of polar relays designed for communications service.

The Instruction Book for the Series 4500 Relay Test Set is much more than a set of instructions for an item of hardware. This 32 page

booklet defines terms, analyzes in detail the essential operating characteristics of polar relays and then describes the parameters for the various tests required to verify these characteristics. Simplified schematic diagrams are given for each of the many tests that may be performed with this versatile instrument. Separate tests are provided for manual measurement of sensitivity, automatic measurement of sensitivity, contact circuit bias in percent, contact circuit break time in percent and leakage current measurement with 500 volts applied between contacts and coils.

Fig. 1 shows the circuit used for manual measurement of trip current or relay sensitivity. One relay coil and the zero center milliammeter, shunted for various current ranges, are series connected between the junction of the voltage divider, R15 and R16, and the contact arm of R10. Thus one end of the series circuit is established at half the supply voltage of 75 volts while resistor R10 allows the other end of the series circuit to be adjusted equally above and below this potential. Assume that the relay contacts are in the MARK position and the arm of R10 is near the center of its adjustment. No voltage difference exists across the relay and metering circuit and no current flows. Advancing the arm of R10 toward R9 will result in current flow from left to right through the relay coil and meter, increasing until the relay armature "trips," closing the circuit to the SPACE indicator light. Moving the arm of R10 toward R11 will result in the reverse condition and the

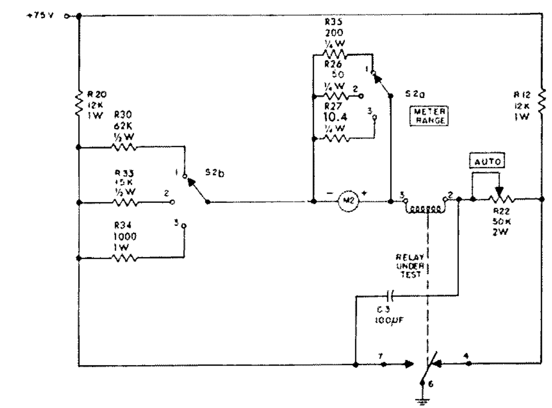


Fig. 2: Schematic diagram of the AUTOMATIC SENSITIVITY test circuit used in the Series 4500. Meter multipliers provide the same ranges as in Fig. 1. The elaborate multiplier network prevents changes in switching speed, determined by R22, when the meter range is changed. Note that C3 is a non-polarized unit.
M1 Milliammeter, ac, 0-5 ma, rectifier type.
M2 Milliammeter, dc, .5-0-.5 ma basic range, 200 ohms resistance.
T1 Transformer, auto, secondary taps at 50, 117 and 250 volts; 117 volt 60 cps primary.

SERIES 72:

Resistance Ohms Each Coil	Turns Each Coil	TS Adjustment Ma. DC	TG Adjustment Ma. DC
		Trips either direction, current in one coil.	
10	600	2.4 — 5.6	9.6 — 14.4
160	2,400	.6 — 1.4	2.4 — 3.6
400	3,700	.39 — .91	1.6 — 2.4
1,000	6,000	.24 — .56	.96 — 1.44
2,500	9,600	.15 — .35	.6 — .9
4,000	12,000	.12 — .28	.48 — .72
SERIES 7:			
150	2,375	3.00	
1,000	——	1.10	
3,100	10,250	0.72	

TABLE I: Standard trip values for Sigma Series 7 and 72 polar relays. Relays of other manufacture, with similar coil resistances, should perform fairly closely to these specifications. Note that the series 7 relays have an extra coil of a few turns between Pins 3 and 5. This coil should be short-circuited to prevent contact bounce.

relay armature will trip to the MARK state. Relay adjustment should be made for the desired sensitivity consistent with equal MARK and SPACE trip currents.

"Hold the relay firmly in the test socket and simultaneously make the MARK and SPACE adjustments, manipulate the appropriate switches and observe for proper meter readings." The answer to the question of where all of those hands come from is found in Fig. 2. In this automatic sensitivity test circuit, the relay is automatically switched from MARK to SPACE condition at a rate slow enough to permit accurate meter readings. This frees both hands to accomplish the required relay adjustments. Regardless of which contact of the relay is closed, the circuit is unstable and the current increases through the relay coil in the direction required to move the armature to the opposite contact. Initially, capacitor C3 is discharged and the charging current of the nonpolarized capacitor holds the voltage across the relay coil to a level insufficient to trip the relay. As the capacitor charges, the current through the relay coil increases and the relay trips. The relay contacts reverse the polarity of voltage applied to C3 and the relay coil. The cycle repeats as long as voltage is applied. Resistor R22 provides an adjustment of switching speed. Table I gives the standard sensitivity test conditions for various relays of the Sigma Series 7 and 72 lines. As noted, this data is generally applicable to relays of other manufacture having similar coil resistances.

Fig. 3 shows the bias test circuitry used in the Series 4500 Relay Test Set. Low, medium and high 60 cycle drive voltages are available to accommodate relays with a wide range of

Sigma Relay Type	Drive Voltage	Full scale of AC Milliammeter	AC Drive Current Bias & Break
72—10TS	LOW	50	30*
72—10TG	LOW	50	20*
72—160TS	LOW	50	15
72—160TG	LOW	50	10
72—400TS	MED	50	10
72—400TG	MED	50	6.5
72—1000TS	MED	50	6
72—1000TG	MED	50	4
72—4000TS	HIGH	5	3
72—4000TG	HIGH	5	2
72—2500TS	HIGH	5	3.8
72—2500TG	HIGH	5	2.5
7—150T	LOW	50	20
7—1000T	MED	50	8
7—3100T	HIGH	5	4

TABLE II: AC drive values for bias measurement of the Sigma Series 7 and 72 polar relays. As in the sensitivity tests, these values should be applicable to relays of other manufacture having similar coil resistances. Values, except as indicated by *, are based on drive applied to only one coil.

coil resistances. In all cases, the minimum drive voltage is used to accentuate relay bias during adjustment so that bias will be minimized in working circuits employing a healthy drive. Table II gives bias test conditions for relays having various coil resistances. M1 is a 5 ma ac milliammeter which is shunted as required to monitor the various ranges of drive current. The bias indicator circuit uses a zero center scale milliammeter in conjunction with the simple divider network shown in Fig. 3B. The resistances are arranged so that equal and opposite currents flow through the meter for the

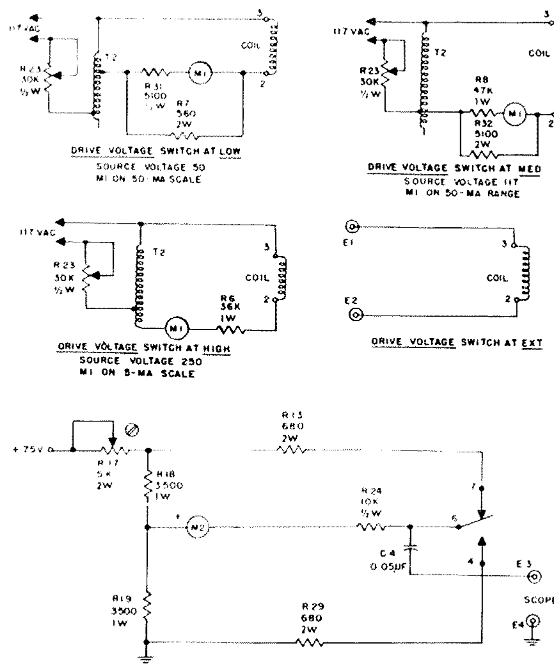


Fig. 3: BIAS TEST circuit used in the relay test set. Drive coil (A) and contact-metering (B) circuits are shown separately for clarity. T2 is a special transformer designed for low exciting circuit so that the unloaded secondary voltage is essentially unchanged by the setting of R23. Meter scale is linear with full scale, .5 ma equal to 25% bias.

MARK and SPACE contact conditions. Using circuitry not shown, the supply voltage dropping resistor, R17, is adjusted for a static meter current of 2.0 ma in both the MARK and SPACE conditions. When drive is applied to a relay which introduces no bias, the meter pointer vibrates around the zero center point on the scale. Bias in the relay under test is indicated by an off-center deflection of the meter. The .5-0-.5 ma meter is calibrated linearly 2.5-0-2.5 and bias in percent is the reading of this scale multiplied by 10. Deflection to the left of center indicates MARKING bias and deflection to the right of center indicates SPACING bias. The relay under test should, of course, be adjusted for zero bias.

Fig. 4A shows the base diagrams of the Sigma Series 7 and 72 relays. This will assist in understanding the other drawings which are keyed to these pin connections. The only difference between the wiring of the Series 7 and 72 relays is that the Series 7 relay has an additional coil, normally short-circuited externally, connected between pins 3 and 5. Incidently, many amateurs have purchased the older Series 7 relays through surplus channels. As a point of information, the oldest of these, the 7JOZ-160T Model D, is the exact equivalent of the 7JOZT-150T. The S425-1 Relay Test Fixture will accommodate the Western Electric 255A relay. The diagram of this unit, shown in Fig. 4B, permits convenient comparison of the terminal connections for the two relay types.

This article has attempted to present the basic circuitry required for the proper adjustment of polar relays used in teletypewriter service. Information and drawings from the Instruction Manual for the Series 4500 Polar Relay Test Set have been used with the permission of Sigma Instruments, Inc. This manual, written by W1BIY, contains such a wealth of additional information that it should be in the hands of every amateur with a serious technical interest in RTTY. Arrangements have been made with Sigma to supply single copies of this booklet to amateurs at the cost price of $1.00. Address your requests directly to Sigma Instruments, Inc., Sigma Division, 170 Pearl Street, South Braintree 84, Massachusetts, attention: Advertising Manager.

. . . W4WKM

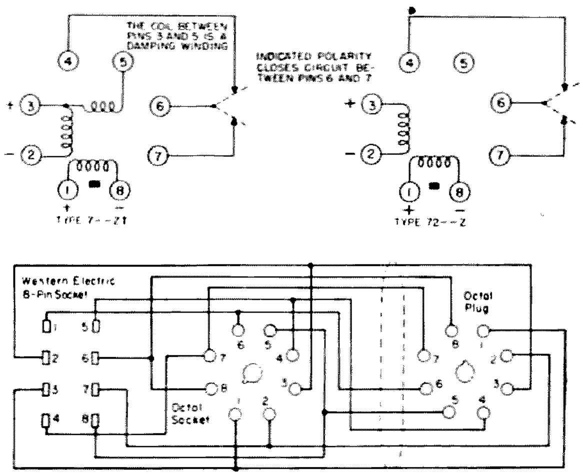


Fig. 4: Schematic diagrams of the Sigma Series Fixture. This unit plugs into the Series 4500 Test Set and, in addition to serving as a jig for adjustment, serves as an adaptor for the Western Electric 255A relay.

Decibels?

It's a cinch

Carlos Robertson K1MRK
39 Gleason St.
Framingham, Mass.

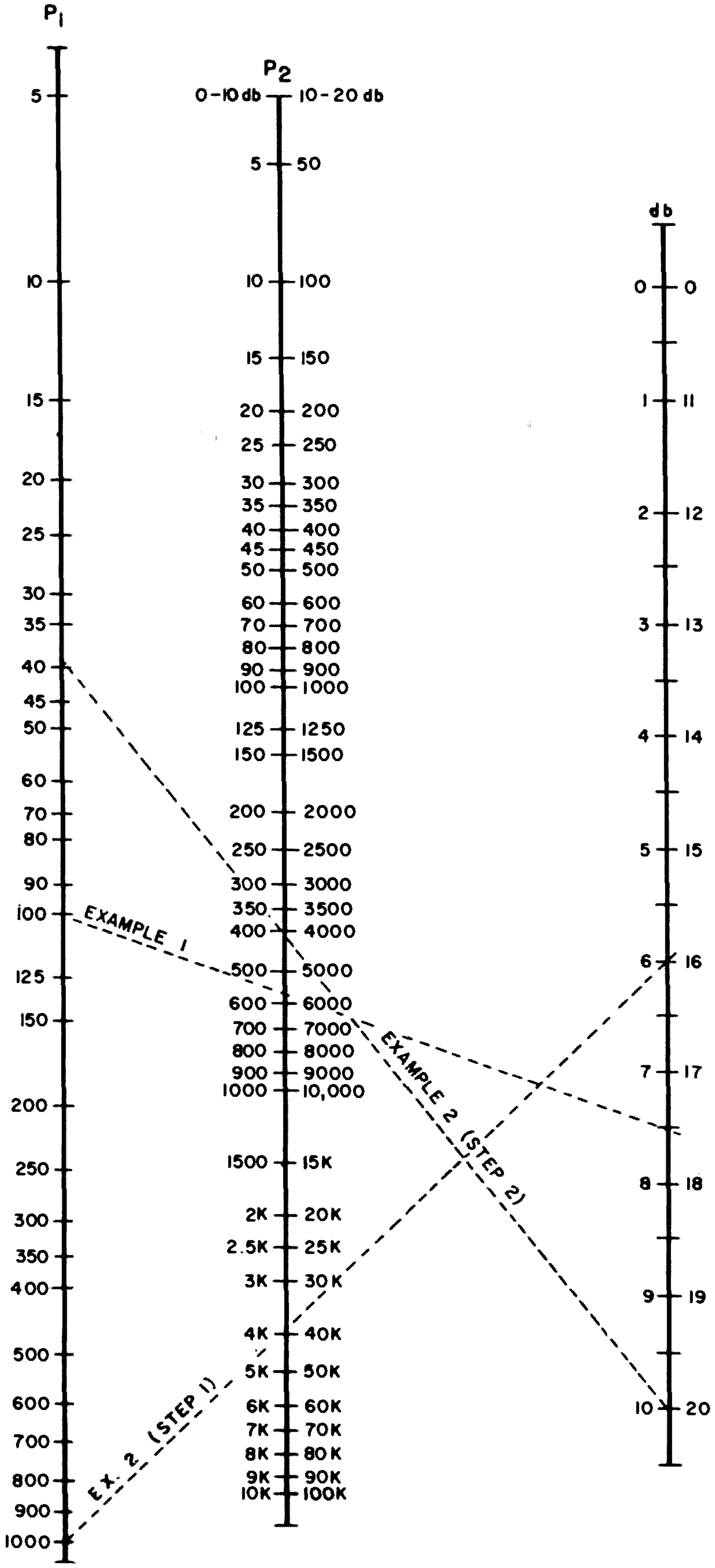
Have you ever had difficulty with a problem involving power ratios expressed in decibels? Did you have the log tables handy? Have you ever wondered what your *effective* radiated power would be if you bought that "Super Signal Squirter" antenna? A simple answer to these problems is a nomograph.

A nomograph is a basic, convenient chart that is easy to use and understand. It graphically solves problems where mathematical formulae are otherwise required.

The accompanying DB Nomograph will allow you to easily determine:

1. The power output of an antenna (knowing

DB NOMOGRAPH



the input power and the antenna gain in db).
2. The power radiated off the back of an antenna (knowing the input power, the forward gain, and the front-to-back ratio).
3. The required input power for a given output power (knowing the gain available in db).
4. The gain, in db, of an antenna (knowing the power input and output).
5. The gain required, in db, for any circuit or device (knowing the power input and the required power output).

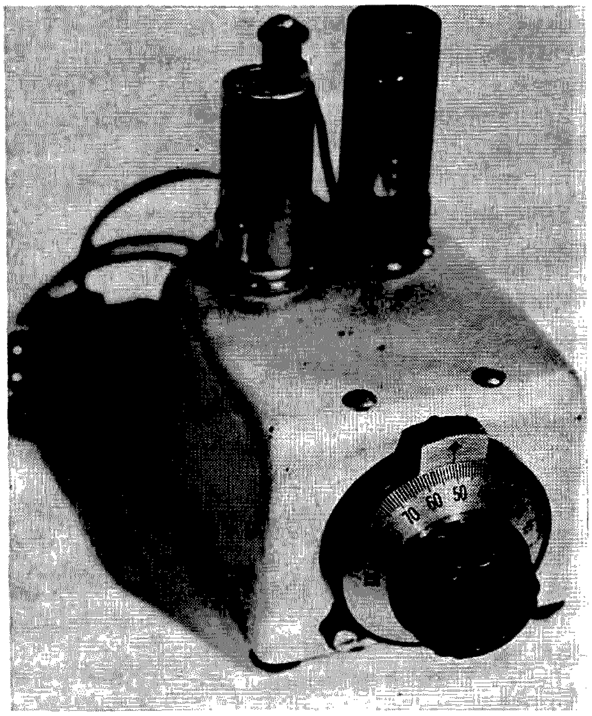
These are but a few of the problems that can be solved by the nomograph. Undoubtedly the average amateur will find many additional applications.

The use of decibels to express a ratio between two quantities is convenient and becoming much more common. You will find that by using this nomograph you will have as much understanding of the use of decibels as you now have in the use of volts and amperes.

Here are some examples in the use of the nomograph:

1. To find the effective power output of a new antenna you will need to know the power delivered to the antenna and the specified gain of the antenna in db. Assume representative values for the example of 100 watts of power delivered and an antenna gain of 7.5 db. Place a straightedge on the nomograph so that it intersects 100 watts on the P_1 scale and 7.5 db on the db scale. The actual effective power output is read on the P_2 scale where the straightedge crosses it. In this example it is 560 watts. In other words, your 100 watter will sound like a half gallon if you connect it to an antenna with 7.5 db gain.
2. Suppose your power output is 1 kw and your antenna has a front-to-back ratio of 20 db with a forward gain of 6 db. You want to know the effective rearward radiated power. Step 1, as in example 1, is to find the forward effective radiated power. Place a straightedge on 1 kw on the P_1 scale with the other end of the straightedge on 6 db on the db scale. The straightedge will in-intersect the P_2 scale at 4kw or 40 kw. Since the forward gain of the antenna is between 0-10 db we read the 0-10 db side of the P_2 scale, or the 4 kw point. Step 2 is to place the straightedge so that it connects 20 db (the front-to-back ratio) and 4 kw on the right hand of the P_2 scale. (Again, be careful to use the appropriate side of P_2; the left hand side applies to ratios of 0-10 db and the right hand side applies to ratios of 10-20 db.) The answer is 39.8 watts, read on the P_1 scale. This is the actual effective power radiated off the back of the antenna.
3. You want to determine what power input is required to provide an effective radiated output power of 3.0 kw. You know that your antenna has a forward gain of 9.0 db. Place a straightedge so that it connects 9.0 db on the db scale and 3.0 kw on the 0-10 db side of the P_2 scale. Read the power input required on the P_1 scale. In this example it is 375 watts.
4. Suppose you have determined that your antenna system makes your 200 watts sound like your friend's 1 kw rig. You want to know the gain of your antenna system in db. Place the straightedge so that it connects 200 watts on the P_1 scale with 1.0 kw on the 0-10 db side of the P_2 scale. The gain of your antenna system is read where the straightedge intersects the db scale. In this example it is approximately 7.0 db.
5. You have a 5.0 watt transmitter and you want to install a new antenna system that will provide an effective radiated power of 300.0 watts. Place the straightedge so that it connects 5.0 watts on the P_1 scale and 300.0 watts on the 10-20 db side of the P_2 scale. If you had tried to use the 0-10 db side of the P_2 scale the straightedge would not intersect the db scale. The gain required of the new antenna as read on the 10-20 db side of the db scale is 17.9 db. We read the 10-20 db side of the db scale because we used the 10-20 db side of the P_2 scale.

Although the examples illustrate the use of the nomograph by comparing antenna characteristics, the nomograph is not limited to solving problems in power ratios related to rf energy. Any quantity of power, be it commercial household power, audio, rf, etc., can also be related in terms of decibels by using the nomograph. . . . K1MRK



Edwin Cole W7IDF
P.O. Box 3
Vashon, Washington

Vector VFO

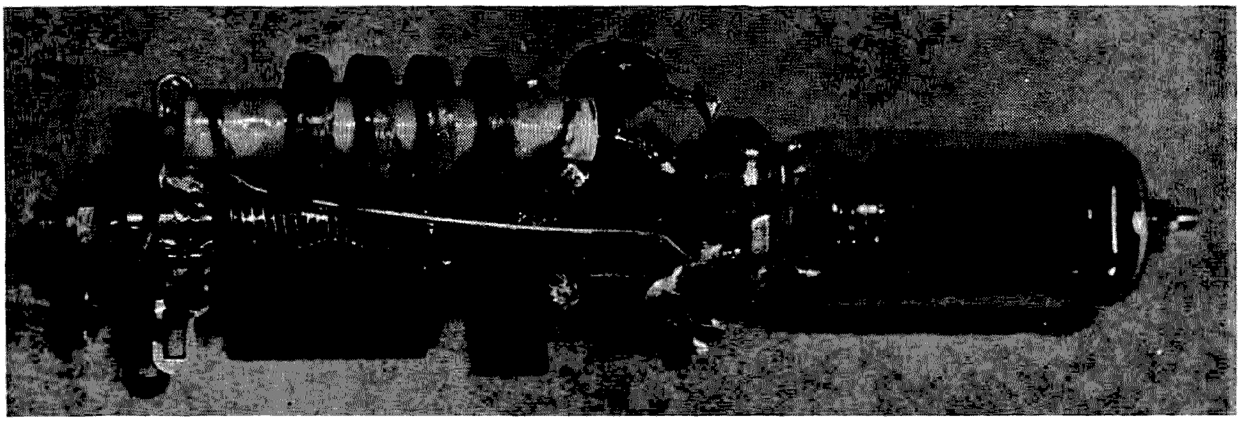
73 Parts Kit Available . . . $6.50

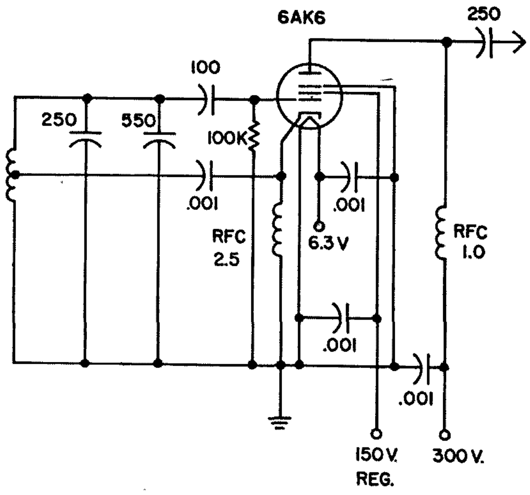
Take one Vector seven-pin turret socket, wind nineteen and one-half turns of Belden #20 Nylclad cathode-tapped at six turns, coat generously with low-loss dope, pad to frequency and serve with DX-60.

It's almost that simple. The only components not mounted on the socket are the tuning variable, the output mica and the plate rf choke. (When the last two are soldered to the plate pin they should be dressed away from the turret to avoid degenerative feedback.) You may prefer to juggle the padder and variable values for junk-box or bandspread considerations but with a 250 mmfd variable the VFO tunes from 3350 to 4050 kc. This range obviously means very little spread on the high bands, but I read my frequency on the receiver dial and it takes only a moment to check calibration before going on the air. The variable I used is a broadcast midget picked for four virtues: double bearings, short shaft, rigid frame, compactness.

The coil and circuit component values are products of eclectic empiricism.* As it happened, the first try was successful. This was suspicious so a duplicate unit was put together, with the same results. Operation for the past

* Cut and try





With the exception of filament disc by-pass all fixed capacitors are silver micas.

six months has been completely satisfactory, with one possible exception. Drive on all bands is more than adequate except on ten phone, where it is about a milliampere short at the 6146 grid. If you find it necessary this could probably be most easily remedied by peaking the slugged coil in the DX-60 or by tuning the plate circuit of the VFO to pick up the second harmonic. Speaking of harmonics at this point, let's remind ourselves that working ten with an eighty meter VFO requires extra attention to the output frequency.

The original plan, as you may have guessed, called for mounting this unit inside the DX-60, but I simply couldn't find a spot where the oscillator wouldn't be subjected to heat and/or mechanical modulation by transformer hum; perhaps someone else will. The chassis shown in the photo is surplus, cast-aluminum and small enough to provide a maximum of rigidity without crowding. An OA2 with its six thousand ohm, ten watt resistor take up some of the extra space on top—where all good heat producers belong.

After warm-up, drift was checked at less than one hundred cycles in an hour. On-the-air requests to a reliably cynical local ham for critical appraisal confirmed the performance as clean and stable. That long axial machine screw looks out of place in the center of a VFO coil, but it doesn't mean you can't use a turret socket to achieve stability in a simple and compact package. . . . W7IDF

Wee Birdcage

The ultimate in limited space antennas

Terrence Banks K3LNZ
426 Orange St., S.E.
Washington 20, D. C.

How would you like a three-element beam for 80- or even 160? Sounds like a pipe dream, of course. But you *can* have an antenna, for somewhere between $5.00 and $20.00, depending on the band, that you can put together yourself, that will occupy no more than a 17 foot turning radium on 160 and correspondingly less on other bands, and that finally will give you a marked improvement over a full size dipole. Just how much improvement will be explained later, but it's well worth the little amount of trouble involved.

The solution is nothing radically new—it is simply an application of someone else's good engineering that went by practically un-noticed several years ago. I am referring to the G4ZU "Birdcage" antenna which appeared in one of the other amateur radio journals in April 1960,

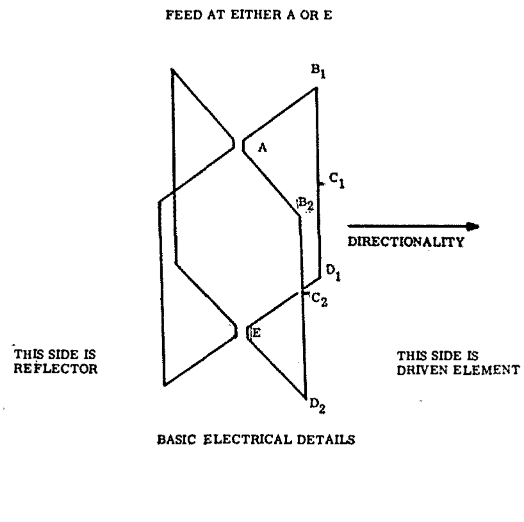


FIGURE 1

plus the additional information that one will work when cut to one-quarter of its original size. This author therefore claims no credit for anything more than sitting at the typewriter and presenting the facts (verified, on the air) and figures.

The basic principle of the Birdcage is shown in Fig. 1. A pair of V dipoles have center points at A and E. One dipole runs from C_1 through B_1 to the centerpoint A, and then on through B_2 to C_2. The other dipole goes around the other way through D_1, E, D_2 and back to C_2. These may look like funny dipoles, but they are merely bent toward the other dipole at B_1 and B_2 and at D_1 and D_2, and are connected together where the tips meet at C_1 and C_2. Assuming A is the feedpoint, if we follow our way around the circuit, we will find that we have one full wave before we get back to A again. This obviously will load up very well on the frequency for which it is cut. The theory behind it is that the inner portions of the two dipoles will radiate in a horizontal plane, and the portions that are bent up or down to connect to the opposite pieces serve merely as a voltage feed, so that one dipole can be fed at its center and then will end-feed the other one. Addition of a reflector constructed in the same manner balances it out mechanically, and gives us additional gain over that obtained by stacking the two dipoles.

When G4ZU's original article appeared, the writer took a quick look at the claimed gain (10 db) and what the size would be when scaled down to six meters, and went looking for materials. Results were very good without even bothering to measure SWR or feedpoint impedance. We just tuned the reflector for maximum forward gain and proceeded to work all the new signals we were hearing. About this time, we made the acquaintance of Skip W3CYT who was also intrigued by the original article. However, he had gone a step further and experimented around with half and quarter size models. Comparing notes revealed that less gain, but otherwise similar results, were obtained in the miniature models. Although no actual figures on gain were ever arrived at, comparison with standard dipoles showed definite improvements in signal strength, and an estimated figure of 4 db does not sound out of line. Fig. 2 shows the physical size of one element (A to B_1, or etc.) for the various bands, both in quarter-wave and full-wave models. It is obvious from this that a full-wave 40 meter model will work as a quarter-wave on 160, and likewise for other possible frequency relationships, up to the quarter-wave

Band	Full-Wave	Quarter-Wave
2 meters	10-5/16"	2-5/64"
6 meters	29-3/4"	7-3/8"
10 meters	4'-4"	13"
11 meters	See Note #1	See Note #1
15 meters	5'-10"	17-1/2"
20 meters	8'-8"	2'-2"
40 meters	17'-4"	4'-4"
80 meters	34'-8"	8'-8"
160 meters	See Note #2	17'-1"

Note #1: Details supplied upon request to other countries. Residents of U. S. need not bother asking.
Note #2: Anyone this ambitious won't have any trouble calculating his own figure.
All lengths given are for one element (8 required), and also represent the turning radius of the antenna. All are given for the low edges of the bands.

Fig. 2—Sizes for Various Bands

six meter model which has a radius of less than 7½ inches!

The mechanical details are shown in Fig. 3. Simply obtain two suitable sized hunks of hard wood. Bore holes for the size of mast you wish to use, and mount them exactly twice the length of one element apart (either a quarter wave for the full-wave model or a sixteenth wave for the quarter-wave model). Next, bore holes for whatever diameter of material you have selected for the elements, which is simply whatever you have around or can purchase cheaply, such as half-inch inside diameter thin-wall conduit. The elements should come close to, but not touch, the center support, and should be fastened in with machine screws in such a way that adjacent elements can be connected electrically by jumpers. See Fig. 4 for details. In most quarter-wave models, no extra support is needed for the elements, nor will any be needed on the higher band full-wave models. However, if you think the elements will have a tendency to droop, simply run the mast a bit higher than the top wood block and run nylon, glassline, or what have you down to the ends of the top elements for support. Finally, connect vertical wires between the tips of the top set of elements and those directly below. These wires may be any size convenient or mechanically desirable, as they carry no current. Likewise, there is no appreciable rf voltage present at the wooden mounting blocks, so no special pains are required to use low-loss material at these points. Finally, element thickness, while theoretically tending to control bandwidth, is so much greater than any wire that might be used in a standard dipole that mechanical size alone should be the deciding factor.

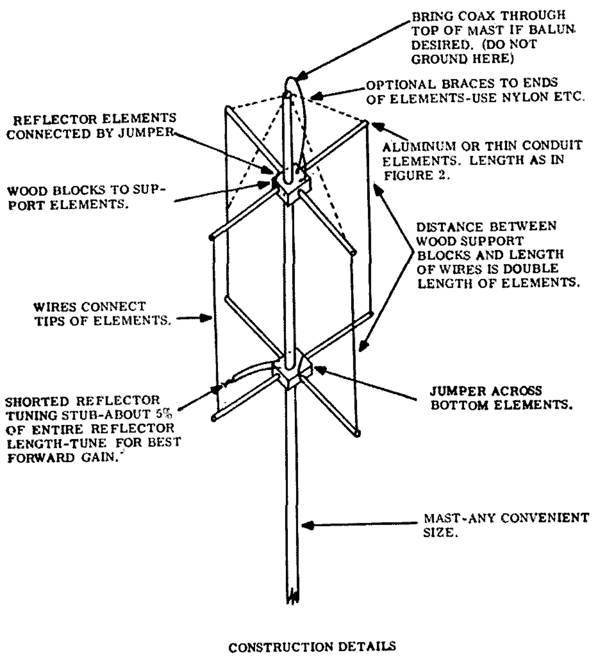


FIGURE 3

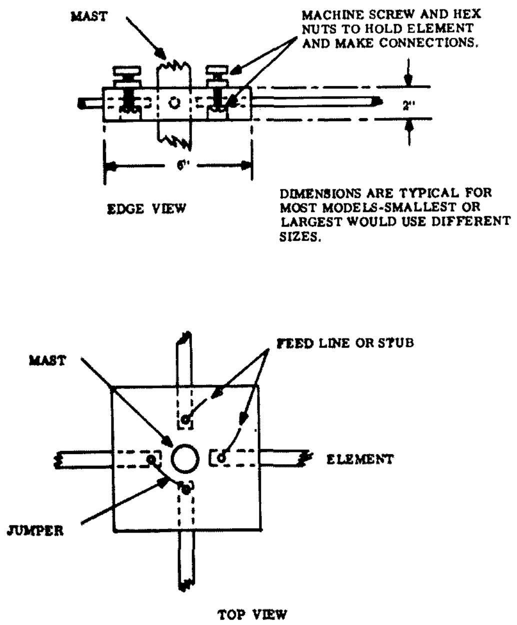


FIGURE 4

To feed the thing, connect a jumper between the two driven element sections at the bottom block, and tap the feedline out from the inner ends of the top elements to obtain the desired impedance (50 ohms will be close in, and higher impedances further out, just as in a "T" match). Now adjust for best SWR by shortening or lengthening the vertical wires slightly. At this point, it would be best to mention that a balanced feed is required. This can be obtained through the customary half-wave loop of coax if 200 or 300 ohm feed is desired. It can also be obtained by using the mast as part of a 1:1 ratio "balun." Run the coax into the mast, grounding the braid as you do, at a point exactly one-quarter wave below the top of the mast. This will be the same

distance as between the wooden support blocks for a full-wave model, or four times this distance in a quarter-wave model. Do not ground the coax anywhere above this point. Separate the braid and the inner conductor where they come out the top, and you will have a balanced feed at the same impedance as the transmission line.

Now connect a jumper between the two top elements of the reflector, and insert a stub of twin-lead the same length as an element between the two bottom reflector elements. This gives us one-sixteenth, or about 6%, of the total reflector length, which we know is too much as 5% is the theoretical figure for how much longer than the driven element it should be. Prune this stub, keeping the far ends shorted, until maximum forward gain is achieved. You can now go back over the two adjustments (driven element and reflector stub) as many times as it takes to make you happy with the SWR and FB ratio if you are of a mind to squeeze out the last milliwatt of power, although the average guy will probably be contented to let things as they are after the first basic adjustments, and won't lose an awful lot by doing so, either.

Several things that should be borne in mind when using this arrangement are that two-band operation is quite practical, as long as there is a 4:1 frequency ratio—that is, operating quarter-wave on 80 and full-wave on 20, or etc. Also the elements can be cross-connected (both halves in series) to make a half-wave (or is it really full-wave?) bi-directional model on the "in-between" band (40 in the last example) although the gain is no better than with quarter-wave operation due to neither side being larger than the other, and neither serving as a reflector. Finally, either the feedpoint or the reflector tuning stub can just as well be either top or bottom, whichever suits your convenience. If you use open line, bottom feed would obviously be more convenient than coming up through the mast as with coax.

As stated before, several of these antennas were built and tried out on six meters. Results were, as close as can be "guesstimated" with nothing but S-meter readings and comparison with dipoles, close to G4ZU's claim for the full-wave model, and a conservatively estimated 4 db gain for the quarter-wave miniatures. Results on receiving tend to back up these figures rather closely.

Lastly, do not expect either (1) a sharp directional pattern, or (2) a large front-to-back ratio. After all, one driven element and one reflector wouldn't give you these in beam configuration either. The side nulls are deep, however, and overall performance is well worth the small effort and expense required to construct one. . . . K3LNZ

Protect Your Investment

Roy Pafenberg W4WKM

ANY amateur who desires to pursue his avocation and at the same time is interested in keeping his kids in shoes and a few cold ones in the box must necessarily be concerned with the trade-in or resale value of his gear. This applies equally to commercial and converted surplus equipment. In order to avoid an expensive turnover of the station with each real or claimed state of the art advance, many amateurs find it desirable to modify their commercial equipment to gain the advantages of new techniques. Of course, extensive modifications are the rule in most surplus conversions.

How do you modify and still not lower the value of your equipment? The Golden Rule applies in this area and results in a very tangible increase of cash in pocket. The potential buyer of your equipment probably desires what you yourself would want. This boils down to new appearance and performance along with detailed instructions and service information. This is a tall order but it can be filled.

A few simple precautions, religiously followed, will insure top market value of modified commercial and converted surplus equipment:

1. Make the minimum modification required to gain the desired performance objective. Plan the modification so that the equipment may be restored to the original condition if things don't pan out. It is sometimes difficult to accomplish the desired modification without punching additional holes in the panel of the equipment. In this connection, new components can be of great value. See "Versatile Control Techniques" in the Aug. 61 issue.

2. First impressions are important and appearance, internal and external, should be up to par. The quality of workmanship in the modification or conversion should at least meet the same standards to which the equipment

was designed and manufactured.

3. Maintain *complete* data on all your equipment.

Of these points, the last is possibly the most important and by far the easiest to goof. While a scrawled sketch on the back of an old bill may satisfy your requirements at the time the work is done, this is rarely true of the prospective buyer of the modified equipment. He wants, and deserves to get, the most complete data you can give him.

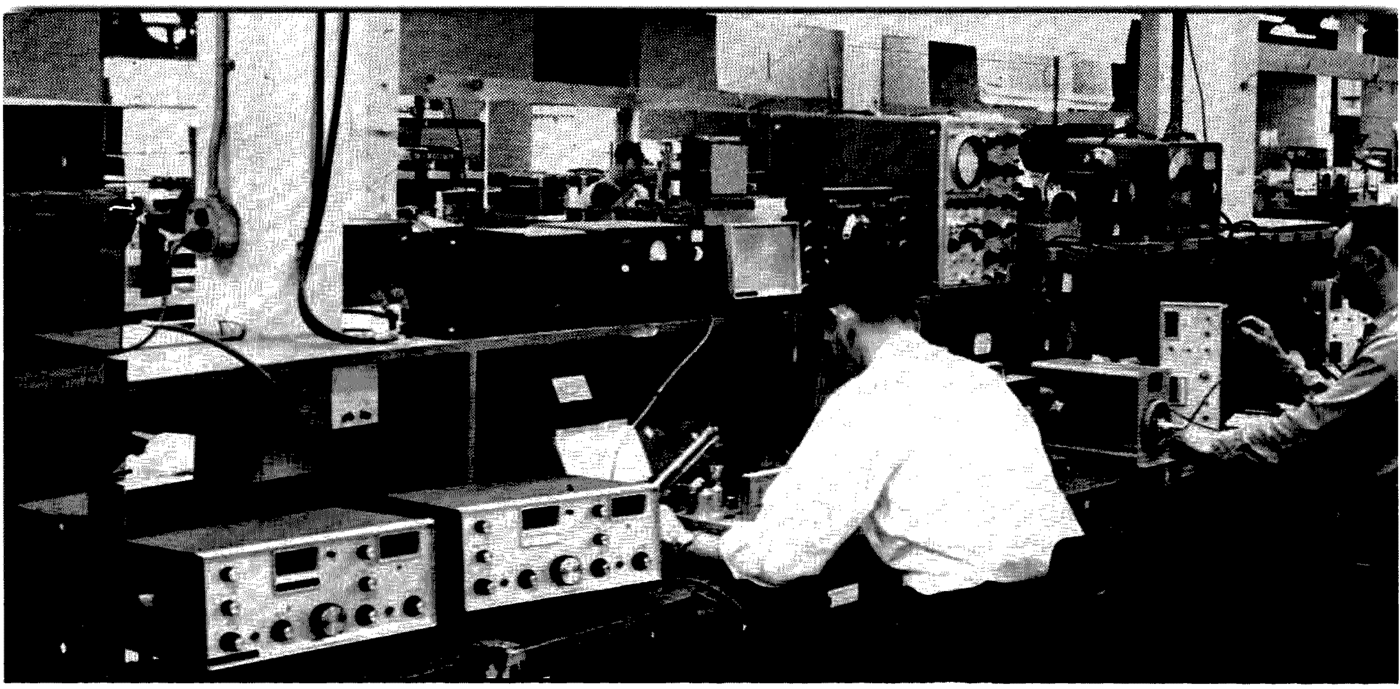
Manila file folders are a good binder for individual equipment information. This is especially true of surplus equipment where the manual, if available, may not cover the actual application. File such information as you can get in the folder. If the conversion is described in a magazine article, clip and file. Schematic diagrams, in particular should be neat and legible, showing all details of the conversion or modification.

Entering changes on schematic diagrams of complex equipment is, in itself, a problem. Stencil correction tape, as pointed out in the blurb in the Aug. 61 issue, can be used to block out sections of the original schematic and corrections and changes entered directly on the tape. It is often detsirable to make copies of diagrams, either from borrowed publications or to pass on. Commercial photostats are ideal but can be quite expensive. In these modern times, many offices are equipped with photographic transfer type duplicating machines. Probably the most popular of these is the Kodak Verifax. Drawings may be duplicated on these machines and the results are quite professional. Maximum size is 8½" x 14" and the cost of materials, per copy, is pennies.

After you complete the equipment file on your modification or conversion, you may feel it is of sufficient value to pass on to other amateurs. If so, you have already completed the hardest part of preparing an article on your project. Duplicate your material, tie it together with some prose and send it to 73 Magazine. You may have a winner.

All in all, time spent on keeping the equipment library current pays off in personal satisfaction and means dollars in your pocket when you dispose of the gear.

. . . W4WKM



A Comparative

W2NSD/1 . . .

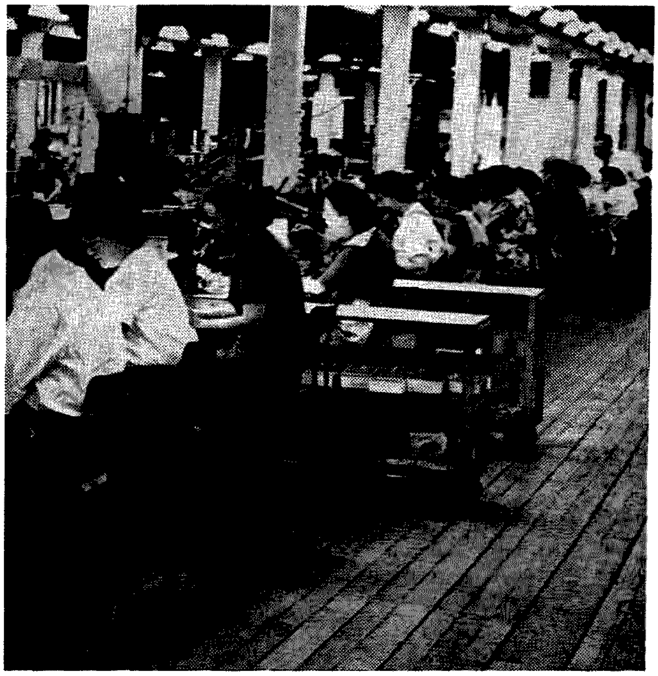
Our little survey back in February indicated that over 20,000 of our readers are planning on going sideband mobile this year. This is not illogical for a great many of us have been waiting rather patiently for the manufacturers to bring out reasonably priced units so we could operate sideband from our cars. The way the fellows with the KWM's have been working out has been an eye opener. I know that I've talked with Antarctica while driving through the streets of New York City.

Transceivers seem to be finding a place in the hamshack too. A great many hams don't feel it is necessary to buy both a receiver and a transmitter when a transceiver does the whole job and takes up a lot less space . . . and ends up costing a lot less.

Even the relatively high price tags of some of the transceivers won't be much of a deterrent for many amateurs are now buying on those old easy terms, which means that a $600 package will probably only cost you about $12.50 per month for three years, plus carrying charges, and you end up with something worth $200 to $400 when you go to trade it in. The fellow who drives to work can figure that his rig is costing him 50c a day. If he has to drive any distance this is well worth it not only for the relief of boredom, but for the friends that he will make through these twice-daily contacts on the bands.

I've tried to give you all of the factors for general comparison on the big chart. There are many other features of each unit that you will want to investigate too, which will send you not only to the paragraph under each photo which has been prepared by the manufacturer, but also on a perusal of their advertising claims.

The field is obviously quite competitive and you'll find that the manufacturers all give excellent value for the investment you make. None of them are overcharging for what you get. Some are able to give a bit more through sophistication of design. Several units keep their cost down by eliminating functions that are not absolutely necessary for sideband mo-



Survey of TRANSCEIVERS

bile operation, though they usually offer either kits of parts to add these omitted functions or else instructions for modifications.

In making your choice of a transceiver you probably will not really look for much in the way of CW or AM capabilities if you are planning on using the rig solely in the car. You may well be able to do without the ten and fifteen meter bands for the next few years while old Sol recovers from his spot-blight. Ops planning on shack use of the transceiver may well consider ten and fifteen of importance, as well as complete coverage of the CW bands, etc.

MARS members should remember that almost all transceivers can be moved out of the bands a bit by the changing of a heterodyne crystal, with the only loss being in calibration.

Look 'em over. Decide whether you want one of these inexpensive Heath one-band jobs to keep you in touch with the gang as you drive around, or perhaps a super delux all-band transistorized Hallicrafters FMP-200.

Transceiver Com

	Date Released	Price	Final Tubes	Input PEP	80M	40M	20M	15M	10M	WWV & 6M
Collins KWM-2	10-59	$1150	(2) 6146	175	3.4-4.0	7.0-7.4	14.0-14.4	21.0-21.6	28.5-28.7 [1]	14.8-15.0
Davco DT20/DR30	6-63	535±	(1) 6146	70	3.55-4.05	7.0-7.5	14.0-14.55	21.0-21.55	28.0-29.55	9.5-10.0
Drake TR-3	4-63	495	(3) 12JB6	300	3.5-4.1	7.0-7.6	13.9-14.5	21.0-21.6	28.0-29.7	50.0-51.5
Elmac ATR-4	5-63	750±	(2) 6146	180	3.5-4.0	7.0-7.5	14.0-14.5	21.0-21.5	28.0-30.0 [2]	
Hallicrafters SR-150	11-62	650	(2) 12DQ6B	150	3.5-4.0	7.0-7.35	14.0-14.35	21.0-21.45	28.0-29.7	
Hallicrafters FPM-200	8-62	1995	(2) 6146	150	3.5-4.0	6.8-7.3	14.0-14.5	21.0-21.5	27.7-29.7	9.7-10.2
Heath HW-12	6-63	120±	(2) 6GE5	200	3.8-4.0 [5]	7.2-7.3 [5]	14.2-14.35 [5]			
National NCX-3	3-63	369	(2) 6GJ5	200	3.475-4.02	6.980-7.315	13.875-14.42			
SBE SB-33	3-63	389.50	(2) PL500	135	3.8-4.0	7.15-7.35	14.2-14.4	21.25-21.45		
Sonar Four Bander [7]	5-63	495	(2) 6GJ5	360	3.795-4.005	7.095-7.305	14.195-14.405	21.295-21.505		
Swan SW-240	2-63	320	(1) 6DQ5	240	3.780-4.020	7.050-7.320	14.130-14.370			
Tranceivers S3B	4-63	299	(1) 6DQ5	240	3.78-4.02	7.05-7.32	14.13-14.37			
WRL Galaxy 300	3-63	300	(2) 6HF5	300	3.8-4.0	7.050-7.350	14.2-14.4			

[1] Can tune other 200 kc segments with crystal change.

[2] Choice of 28.0-28.5 or 29.0-29.5 and 28.5-29.0 or 29.5-30.0 mc.

[3] Power supply for xmtr still not firm. Receiver power supply includes speaker, Q-multiplier and ac supply.

[4] Rig provides normally used sidebands for each band. Extra crystal available for opposite sidebands as an accessory.

[5] Heath HW-12 covers 80M only. HW-22 covers 40M; HW-32 is for 20M.

I've tried to include just about all of the specifications which will be of general interest in comparing the various makes of transceivers. All of these figures are the best that I could round up. There may be some variation, particularly in units which have not yet been released . . . and the prices obviously are subject to minor fluctuations as indicated by plus-minus signs.

You'll find the first release of information on some units soon to be unveiled on the chart and in the following pages. With the exception of the Sonar units and the Transceivers, Inc. units from whom we were unable to get sufficient information by presstime, I believe that we have covered the sideband transceiver field rather thoroughly.

Keep in mind that the writeups under the photographs were prepared by the manufacturers with the idea of supplimenting the info in this chart.

With the exception of the SBE unit which has the loudspeaker built in, all transceivers require either an external speaker which is normally built in the ac supply or else they depend upon your using the regular car radio speaker.

The exact frequency coverage is given here in detail for those fellows who might be influenced by the ability of a unit to cover MARS channels, or other frequencies adjacent to our ham bands.

Almost all transceivers have provisions for turning a linear on and off when the unit is used in the shack.

Three of the units are largely transistorized, the Hallicrafters FPM-200, the SBE SB-33 and the Davco combo. Tubes are used only in the higher power rf stages. Since transistors are more efficient than tubes these units are naturally a bit more efficient than tube units, though they may not make any difference to

parison Chart

	I.F.'s (mc)		Size													
Sidebands	1st Conv.	2nd Conv.	H	W	D	Weight	VOX	100 kc Calib	S Meter	Sideband Generation	Bilateral [8]	Dial (kc) Calibration	Mtg Bracket	AC Power Supply	DC Power Supply	Total Rig, MB, AC&DC P.S.
both	2.8-3.1	.455	7 3/4	14 3/4	13 1/4	18	inc	inc	yes	455 kc mech	no	1	$120	$115	$198	$1583
both	1.95-2.5	.455	7	8	5 3/4	11	inc	inc	yes	455 kc mech	yes	10 [9]	Inc	36 [8]	? [6]	571+
both	9.0		5 3/8	10 3/4	14 1/4	12	inc	inc	yes	2-9 mc xtal	±1kc	10 [9]	Inc	80	130	705
both			5 1/2	15 3/4	9 5/8	19	inc	inc	yes	2.7 mc xtal	±1kc	5	— [6]	— [6]	— [6]	950±
both	6.0-6.5	1.65	6 1/2	15	13	17	inc	inc	yes	1650 kc xtal	±2kc	5	40	99.50	109.50	859
both	2.1		5	16	11	26	inc	inc	yes	2.1 mc xtal	yes	1	inc	inc	inc	1995
S	2.3		7	13	11	12	inc	$8.95	yes	2.3 mc xtal	no	2	inc	HP-23 [6]	HP-13 [6]	? [6]
SX [4]	5.2	5.2	6	13 5/8	11 5/8	20	inc	acc [6]	yes	5.2 mc xtal	no	5	inc	110	120	599
both	2.282	.455	5 1/2	11 3/4	10 1/4	13	$29.50	$27.50	no	455 kc mech	no	10	12.50	inc	59.50	449
both	2.959-3.155	.455	5 3/4	11 3/4	11 3/4	11	inc	inc	yes	455 kc mech	no	5	8	134	154	763
SX [4]	5.175		5 1/2	13	11	12	no	no	no	5.175 mc xtal	no	5	inc	95	115	530
SX [4]	5.175		5 1/2	13 1/4	11	10	$39		yes	5.175 mc xtal	no	5	inc	99.50	99.50	500
both	9.1		7	15	13 5/8		$19.95	no	yes	9.1 mc ph	no	10	15	80	120	515

[6] No price yet set.

[7] Sonar also is producing a set of monobander transceivers which cover any 200 kc segment of the 80-10 meter bands. These units are very similar to the Four Bander except for frequency coverage and a lower price of $395.

[8] Bilateral operation, in the sense intended here, has to do with being able to tune the receiver separately from the transmitter. CW ops and SSB DXers sometimes find this of advantage.

[9] Plus one kc calibration on tuning knob.

your car's electrical system.

As an old-time mobileer I have been waiting for these transceivers just as much as you have. I used to enjoy keeping in touch with the gang around New York on 20 meters back when the sun spots were in their last low. As DX improved I found mobiling more and more frustrating with AM and I decided to wait until low cost sideband was here. Now it's here and I'll be mounting one of the rigs in my little Porsche and you'll be hearing me putting around up here in the wilds of New Hampshire Porsche-Mobile.

There really is nothing like having a rig in the car to make trips more enjoyable. Even with a car that is as much fun to drive as mine I find myself shying away from avoidable one to two hour trips unless I am able to use the time to make a few contacts, in which case the trip is over before I know what's happened.

In this day of multi-band transceivers it might be a good idea to put a little sign up in the back window of the car telling what band you are on so the ham that passes you or is behind you can give you a call. It is a lot of fun to drive along talking to another fellow that you've just happened to meet. I drove all the way from New York up to Northampton, Mass. one time talking away happily with a chap I chanced to be following. We stayed about a mile apart to keep from blocking each other.

Your mobile rig is a key to any town you visit too. I have frequently been able to work up spur of the moment midget hamfests by breaking in on a local group as I drove into town. Mobile operation is one of the facets of our wonderful hobby that gives rich rewards, so get yourself rigged up and gas up.

. . . W2NSD/1

DT20 DR30

DAVCO

113 Norwood Ave., Asheville, N. C.

$571^{\pm}$

Two thousand designers—that would be quite a staff for any company. But that's how many hams we talked with before deciding what our new line of equipment should offer. They said they wanted transceiver convenience, but separate VFO's for chasing DX; we gave them both. They needed all the bands, not only for ragchewing on the high bands but because the sunspots won't be uncooperative forever; we put in *full* coverage of 80 through 10, even the foreign segments, and then some. Is 6-meter coverage too much to expect? We don't think so. Think what that means! They asked for AM & CW, along with the high-performance SSB, so we provided three positions of receiver selectivity, including a Collins mechanical filter and a CW crystal filter, and worked out good keying characteristics on the transmitter. Of course they insisted upon good stability; we had to work a long time to provide it at the temperature extremes they encounter. Almost everybody would add a crystal calibrator, so we did it for them and even provided WWV coverage. They asked for a transmitter power level which wouldn't require overhauling of the electrical system of the family bus, yet they wanted enough for a really emphatic signal mobiling and enough to drive a linear back home. Oh, they asked for lots of things; we put in independent broadcast coverage, a built-in VOX, selectable AGC time constants, extra band positions for MARS, etc., a crystal controlled carrier generator and BFO for USB and LSB, a tuning ration that gives 10 kc to a turn, and everything else that you expect. Then we made plug-in subassemblies of all this, held them together with a really rugged (and heavy) chassis, and wrapped it all in fiberglass cabinets that don't shrink from field-day duty.

We had to borrow freely of the components and techniques of the computer-and-missile crowd in order to do all of this, and we don't quite know how to characterize the results. In pure performance and versatility, the DAVCO DR-30 and DT-20 must be ranked with the best fixed-station rigs, but the small size and ease of operation make them quite logical mobile or portable rig choices. And what an outfit for DX-peditions (besides the performance, hand luggage goes through customs a lot easier!)

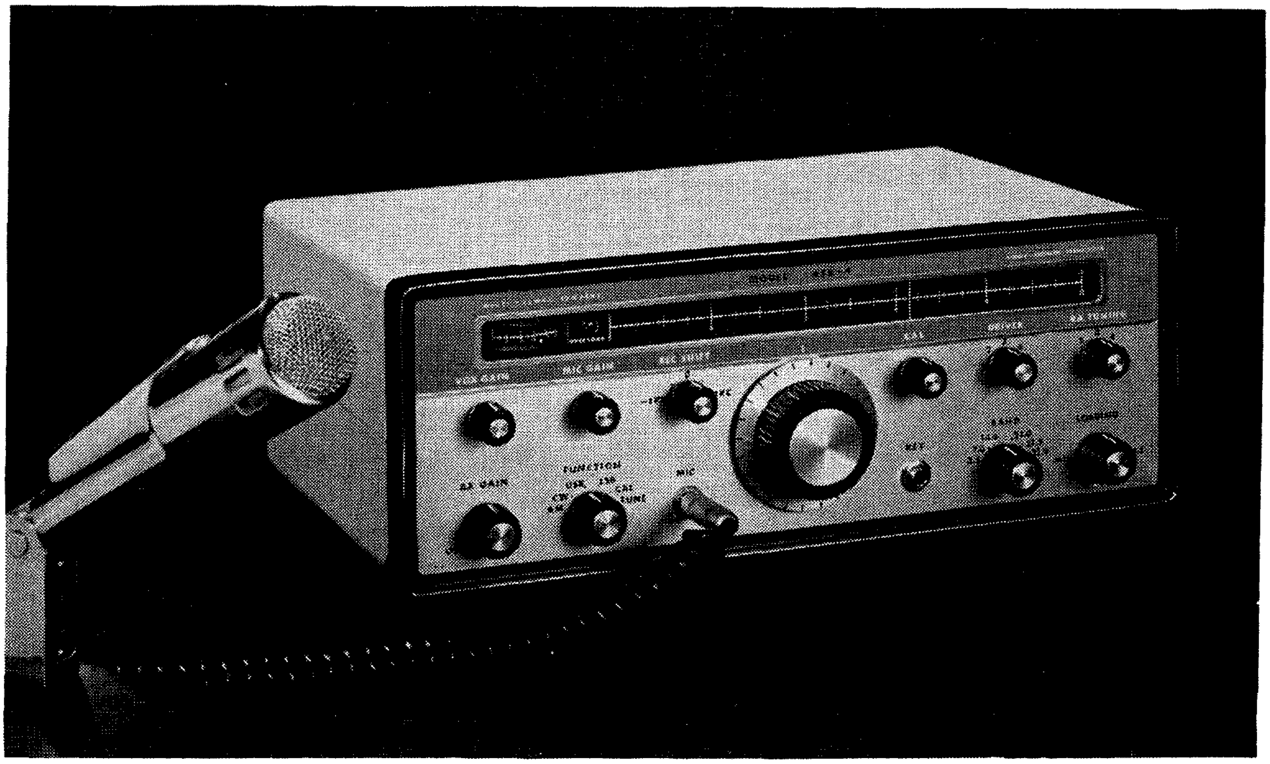
Our 2000 friends gave us quite an assign ment, and it took us darned near three years to fill it. We sincerely hope that the results are a significant contribution to the application of space-age technology to the amateur field.

TR-3 **$495**

R. L. Drake Company Miamisburg, Ohio

(See page 12)

The Drake TR-3 has been engineered for optimum performance on upper or lower sideband with AM and CW included for the ham who likes variation or who desires to contact stations limited to these modes. It was deemed necessary to have complete coverage of all amateur bands 10 thru 80 meters using seven 600 kc ranges. A HIGH STABILITY PERMEABILITY TUNED VFO tunes the same range on all bands. DIAL CALIBRATION: 10 kc division on main tuning dial with interpolation to 1 kc on tuning knob skirt. *TRANSMITTER SPEC: SSB:* 300 watts P.E.P. input, VOX or PTT. Two special 9 mc crystal filters provide sideband selection, without the necessity of shifting any oscillators. The 9 mc filters are asymmetrical, that is steeper on the carrier side making possible unwanted sideband suppression of more than 40 db and carrier suppression of 50 db. Overall audio frequency response 400 to 2500 cycles at 6 db down. Distortion products 30 db down at maximum output. *CW:* Power input 260 watts. Carrier is shifted approx. 1000 cycles into one sideband and mixer is keyed. *AM:* Controlled carrier AM screen modulator is built-in. 260 watts P.E.P. input. Low carrier power increases 6 times to 50 watts output at maximum modulation. This system is compatible with SSB linear. Manual transmit/receive switching for both CW and AM. OUTPUT IMPEDANCE: Nominal 50 ohms, adjustable with pi-network. SEPARATE METERS for receiver S-meter and transmitter plate ammeter. *RECEIVER SPEC:* SENSITIVITY less than ½ microvolt for 10 db S/N I.F. SELECTIVITY 2.1 kc at 6 db, 7.5 kc at 60 db. SEPARATE RF AND AF GAIN CONTROLS. FULL AGC on received modes—audio output varies less than 3 db for 60 db change in signal level. Any amount of AGC from zero to full can be had by adjustment of RF gain control. Time proven Drake AGC system provides fast attack and slow release with noise pulse suppression, no pumping or popping evident. PRODUCT DETECTOR RECEPTION OF AM requires zero beating signal. Advantages over diode detectors include no selective fading, choice of either sideband, and better audio frequency response at 2.1 kc selectivity, resulting in more QRM free QSO's. The accessory *RV-3 Remote Receiving VFO* permits reception of DX and other stations operating from a few cycles to several hundred kc off your transmitting frequency. POWER SUPPLY REQUIREMENTS: Due to the 300 watt P.E.P. input rating the TR-3 will require a power supply capable of low voltage at high current with very good dynamic regulation. Voltage and current requirements: (1) 650 volts at 300 ma average and 500 ma maximum with 10% regulation from 100 ma to 500 ma and maximum ripple of less than 1%. (2) 250 volts at 175 ma. with 10% regulation from 150 ma to 180 ma. Maximum ripple must be less than 1%. (3) −45 to −65 VDC adjustable filtered bias into 33K ohm load. (4) 12.6 volt AC or DC at 5.5 amps. Write for descriptive brochure.



The MULTI-ELMAC Model ATR-4 Transceiver provides complete coverage of the 80M through 10M Amateur bands. Upper and lower sideband operation with excellent carrier and sideband suppression marks the basic design, but AM (USB with carrier) and CW with adjustable sidetone completes the requirements of the most versatile amateur. The features, to mention a few, include VOX, manual keying, break-in CW, 100kc calibrator, and adjustable VFO dial drag. A unique PTO with a tuning ratio of 20kc/turn is nearly linear and is mechanically superior in design. An overload indicator that measures final amplifier grid current provides a positive visual indication of flat-topping and simplifies adjustment of the mic gain for optimum clean output. The indicator aids the tune-up procedure and shows the 100% modulation level for AM operation.

The sideband generator has good long term carrier suppression requiring no field adjustment. Sideband rejection and additional carrier suppression is obtained with a 5.420mc crystal filter containing six crystals. The audio characteristics are shaped to provide a high intelligence power level and a crisp sound on-the-air. The final amplifier contains a pair of 6146's in parallel operating into PI network with adjustable antenna loading.

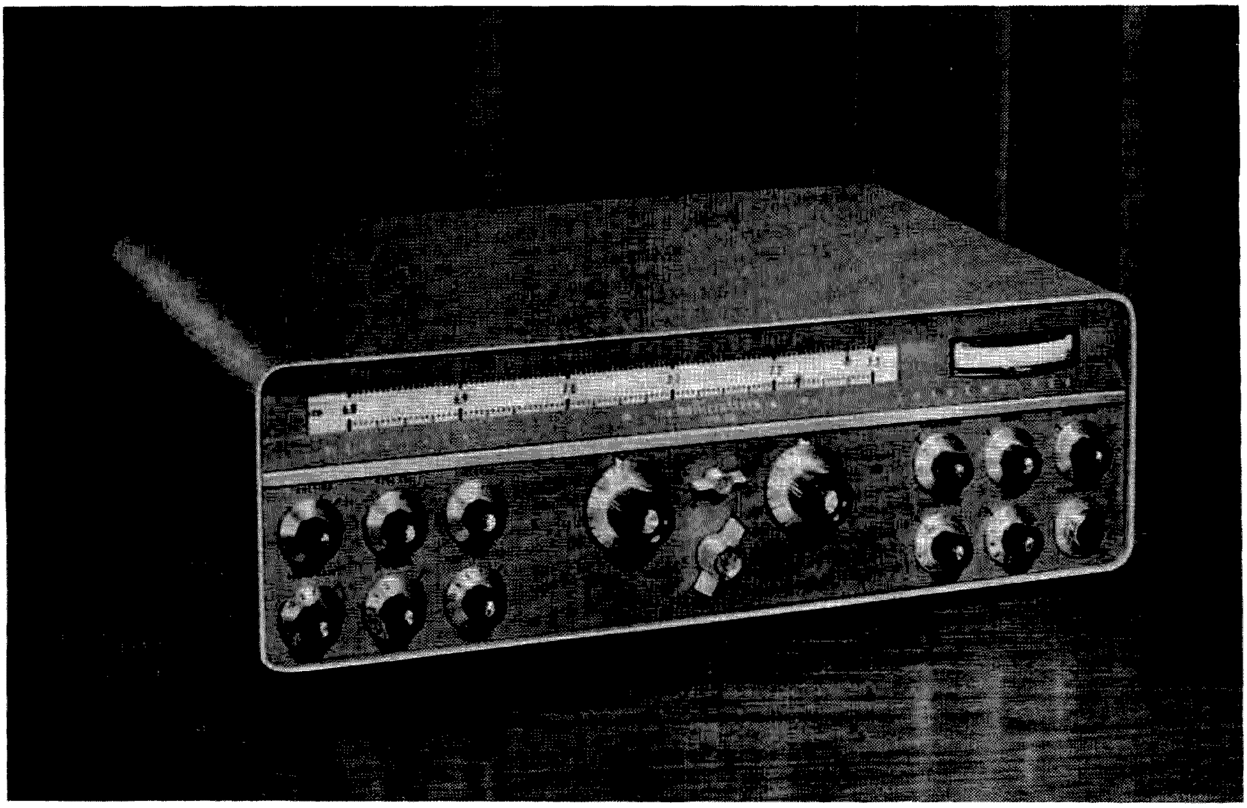
The receiver utilizes a product detector and optimum AVC characteristics for SSB operation. Receiver shift control provides a plus and minus 1 kc tuning of the received frequency independent of the transmit frequency.

ATR-4

Elmac

21470 Coolidge Hwy.
Oak Park 37, Mich

$750 ±



FPM-200

Hallicrafters

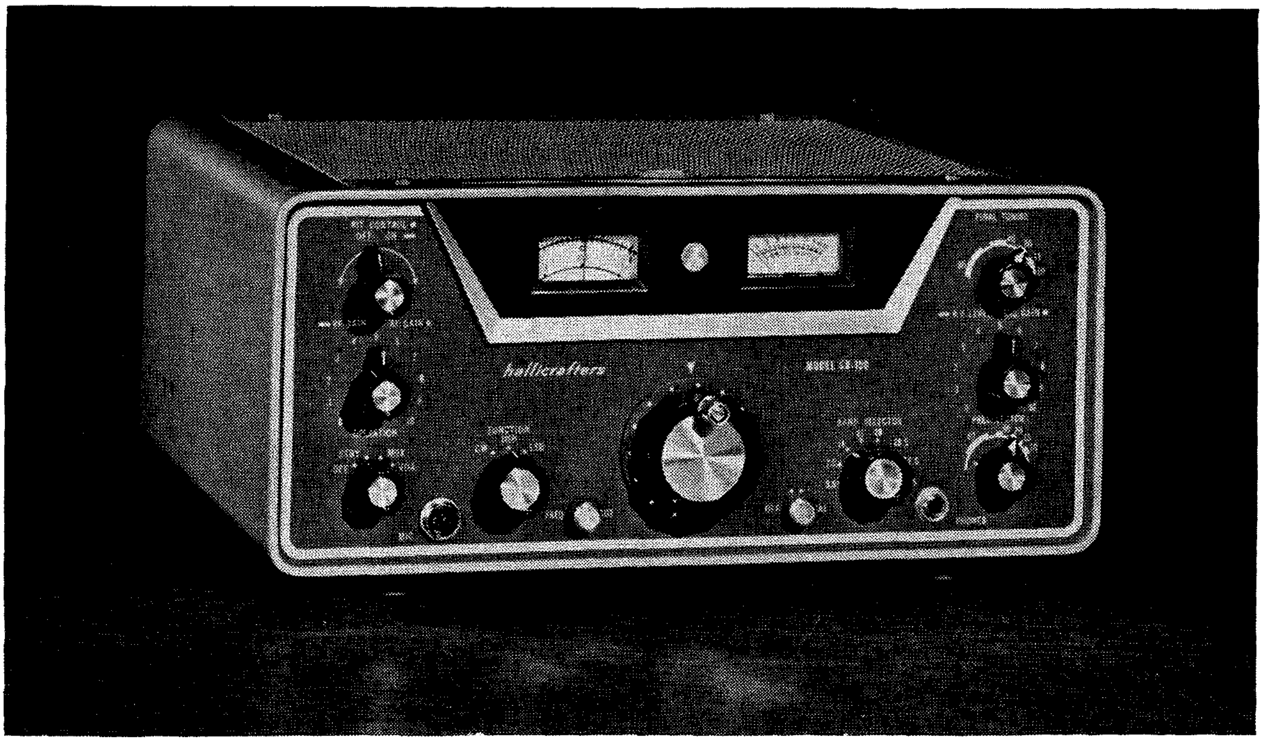
Chicago 24, Illinois

$1995

The Hallicrafters Model FPM-200 Transmitter-Receiver/Transceiver is a complete, compact, self-contained radio station of advanced design. The versatility of the Model FPM-200 permits it to be operated as a fixed, portable, or mobile equipment. The unit is of the hybrid type using a combination of 41 transistors, three vacuum tubes, and two gas tubes. The power supply, the receiver circuits, and the low-level transmitter stages are completely transistorized. The high power stages of the transmitter use three vacuum tubes to develop the required power for transmitting and two gas tubes to regulate the screen voltage for the final amplifier stage. The Model FPM-200 equipment provides for amplitude modulated (AM), continuous wave (CW), and single-sideband (SSB) transmission and reception on the 80, 40, 20, 15, and 10 meter bands. An additional range is provided in the receiver for the reception of station WWV on 10 MC. Each tuning range is 500 KC, readable directly in kilocycles.

Two tunable oscillators (VFO's) are provided with selection to permit the equipment to operate as an independent transmitter and receiver on different frequencies within a given band, or to operate as a transceiver on one frequency—both functions being controlled by one oscillator.

A built-in, 100-KC crystal oscillator permits a front-panel adjustment for calibration of the VFO kilocycle dials.



SR-150

Hallicrafters

Chicago 24, Illinois

(See cover two)

The Hallicrafters Model SR-150 Transceiver is a precision-built, compact, high-performance radio equipment of advanced design. This transceiver utilizes 19 tubes and a dual conversion IF to provide for the transmission and reception of single-sideband (SSB) and continuous wave (CW) signals on the 80, 40, 20, 15, and 10 meter bands.

The versatility of SR-150 equipment permits it to be operated as a fixed station or as a mobile equipment. A 117-volt, 50/60-cycle, AC power supply, complete with speaker (Model PS-150-120), is available for fixed-station use; a 12-volt DC power supply, Model PS-150-12, and a mobile mounting rack (Model MR-150) are available when the transceiver is to be used in a mobile configuration.

An advanced feature of the SR-150 equipment is the Receiver Incremental Tuning (RIT) control. This control enables the operator to unlock the receiver frequency and tune the receiver approximately two KC either side of the transmitter frequency. Flipping the RIT switch OFF automatically returns the equipment to the transceiver condition.

$650

HW-12

Heath Company

Benton Harbor, Mich.

$120 ±

Here in a single, neatly styled unit are provided complete transmitting and receiving facilities suitable for either "mobile" or "fixed" station operation. The only other accessories required for immediate "on-the-air" operation are the Heathkit HP-13 DC or HP-23 AC power supply, a PTT microphone such as the Heathkit GH-12 ($6.95) and an antenna.

Features include a deluxe fourteen tube heterodyne circuit, 200-watts peak envelope power input to the final amplifier, a highly stable low frequency VFO, crystal-lattice filter for SSB generation, automatic level control for greater talk power, built-in PTT and VOX circuits and provision for operation with a linear amplifier. Provision is also made for a plug-in 100 kc crystal calibrator for accurate band-edge marking at 100 kc points, Kit HRA-10-1, $8.95.

Assembly of the HW-12 is easy with over 90% of the components mounted on a heavy-duty circuit board. A pre-cut, cabled wiring harness and easy-to-follow instructions further simplify assembly. The rugged one-piece steel chassis is welded and braced for rigidity and stability. Gimbal mounting bracket included. Average construction time is 15 hours.

NCX-3

National Radio Company

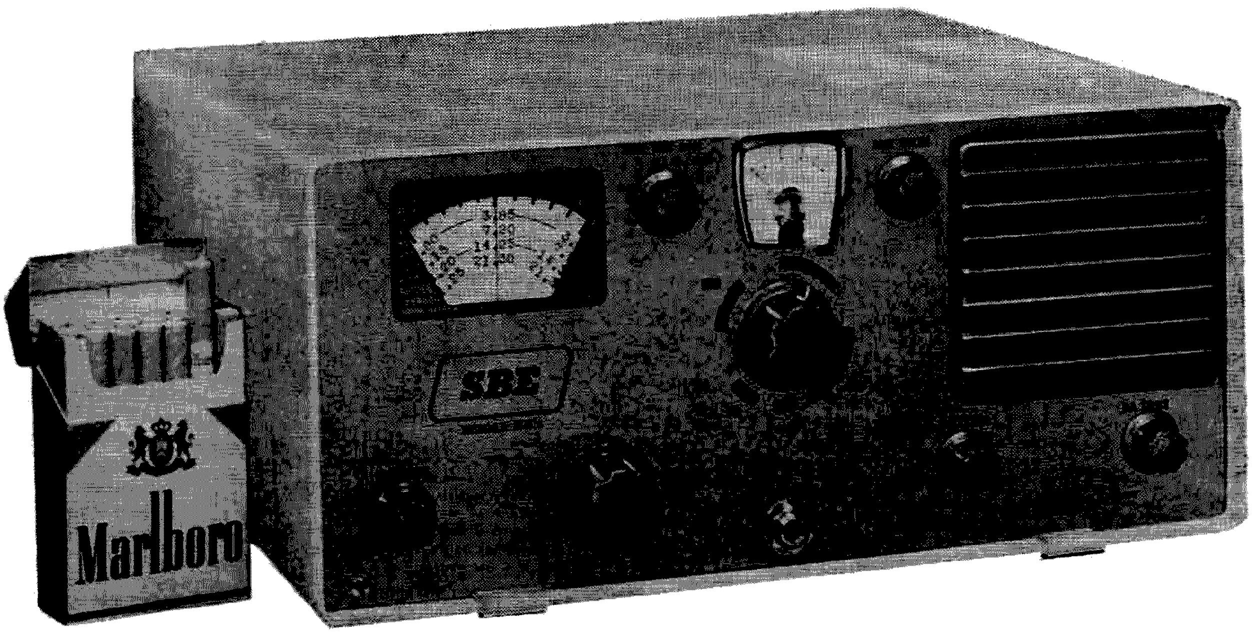
Melrose, Mass.

(See cover four)

$369

National's NCX-3 transceiver is a rugged, handsomely styled unit designed for high performance fixed station use as well as for portable or mobile operation. In order to meet this requirement of dual application, the NCX-3 covers both phone *and* CW portions of the 80, 40, and 20 meter amateur bands (one of the few transceivers which do so), and incorporates *built-in* VOX and break-in grid block keying. VOX sensitivity, delay, and anti-VOX are adjustable, as well as CW break-in release time. The NCX-3 has an automatically switched S-meter/PA cathode current meter, and is the only SSB transceiver on the market with separate AM detection for full AM compatibility. The variable Pi-network final amplifier uses two 6GJ5 pentodes for a *conservative* 200 watt PEP input with only 700 volts B+, and the 40 watts of plate dissipation available is almost twice as high as in some other transceivers with similar PEP ratings.

Operation is on lower sideband on 80 and 40 meters, upper sideband on 20—a different carrier oscillator crystal may be installed should operation on the infrequently used "opposite" sidebanks be contemplated. Fast attack, slow decay, RF-derived AGC is provided for "thumpless" gain control on SSB and CW, which together with product detection and a 45:1 splitgear/planetary drive allow effortless tuning of signals. SPDT relay terminals are incorporated for control of an external linear amplifier, and a gimballed, positive-lock mobile mount is provided with the NCX-3 at no extra charge. The NCX-3 uses 18 tubes and six diodes, and measures only 6 1/16" H x 13⅝" W x 11⅝" D. Matching NAXA AC supply/speaker console for fixed station operation and NCXD DC supply for mobile provide all necessary operating voltages. The NCX-3 and its accessory power supplies are being delivered now, and are warranted by National's one-year guarantee.



SB-33

Sideband Engineers Inc

Rancho Santa Fe
California

(See page 29)

$389.50

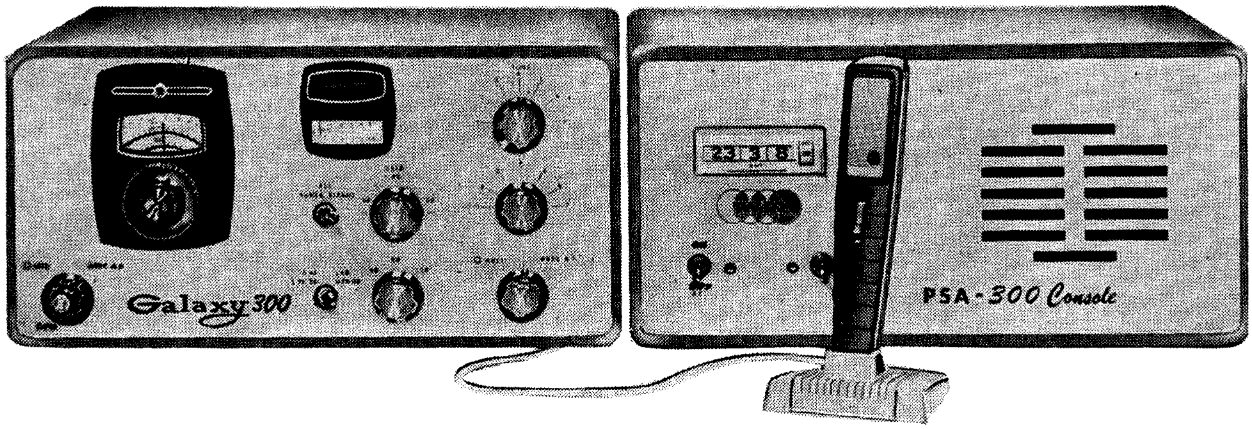
The SB-33 Single Sideband Transceiver, produced by Sideband Engineers Inc., Rancho Santa Fe, California, provides selectable single sideband operation on the 75–, 40–, 20–, and 15–meter amateur phone bands. A 2.1 kc Collins mechanical filter used in both transmit and receive, gives exceptional selectivity. All circuitry is solid-state, with the exception of the high level stages (driver and power amplifier). Bilateral stages which operate in one direction on receive, and in the other direction on transmit, eliminate duplication of circuitry, and permit selection of upper or lower sideband without carrier shift. An a-c power supply and speaker are included in the basic package, resulting in a complete fixed station installation in less than one-half cubic foot. Mobile operation is possible through use of an inexpensive d-c to a-c inverter which is furnished as an accessory. A VOX-audio compression unit is also available as an accessory.

SPECIFICATIONS

Frequencies—3.8 to 4.0 mc, 7.15 to 7.35 mc, 14.2 to 14.4 mc, 21.25 to 21.45 mc.
Receiver Sensitivity—Better than 1 uv for 10 db signal to noise ratio
Tube and Semiconductor—3 tubes, 20 transistors, 14 diodes
Complement Power Consumption—Receive 35 watts, Transmit 165 watts
Dimensions—5½ in. high, 11¾ in. wide, 10¼ in. deep
Weight—15 pounds, approximately


MIC GAIN
RECEIVE TRANSMIT
TUNE
BAND
P.A. TUNE
P.A. LOAD
EXCITER
SWAN
SW-240
SINGLE SIDEBAND TRANSCEIVER

(See page 6)



Galaxy 300

World

Radio

Labs

Council Bluffs, Iowa

(See cover three)

$300

As active hams, we here at World Radio feel that the major advantages of the Galaxy 300 over other available rigs are:

1) The conservative 300 watt power level, PEP . . . by using a pair of the new G.E. Compactron 6HF5's, a tube similar to the 6DQ5, but with increased plate and screen dissipation, smaller and with better high frequency performance.

2) You have a choice of sidebands with no carrier shift since the VFO is shifted an amount equal to the difference in crystal frequencies. This means you don't have to retune when you shift sidebands.

3) Automatic Load Control keeps the average talk power up.

4) Outstanding receiver performance. This is a combination of the super-smooth dial, a combination of planetary and spring loaded anti-backlash gearing gives a two-speed dial with a choice of 72:1 or 12:1 for slow and fast tuning. There is no dial cord to slip or wear and no detectable backlash. Adjustable hairline for minor calibration shifts. The 9.1 mc crystal filter results in 2.7 kc selectivity at the 6 db points and 6.5 kc at 50 db! S-meter is calibrated in S units and db over S-9. Audio derived AVC is remarkably smooth. 2½ watts of audio output, plenty even for the noisiest cars.

5) Stability. The VFO is completely boxed in 16 gauge steel.

6) There are dozens more features to the Galaxy 300, but the best one of all is the price which is possible only because we sell "Direct to the Ham," thus passing along the middleman savings.

MONEY SAVING! SPACE SAVING! QSO SAVING!

Just $279.00
Amateur Net

Features the sensational Eimac 3-400Z high-mu Triode. No Grid or Screen Bias Needed. Low Distortion!

THE DESK TOP

Loudenboomer

MARK II RF LINEAR AMPLIFIER
by RADIO INDUSTRIES, Inc.

There's something about the MARK II Linear Amplifier that reminds you of the good old days!

Perhaps it is the husky, conservatively rated components—that loaf along without strain. It may be the straightforward layout that makes all components easy to reach. Or, it could be that Total Look of sturdy reliability. Or—the low, low price!

Rest assured, though . . . with all its old fashioned appeal, the MARK II is as modern and advanced as tomorrow! The smart two-tone gray enamel cabinet measures just 14⅛" x 12⅞" x 7⅛". . . fits nicely on your operating desk. And the crisp performance of your MARK II will give you consistent QSO successes on even the most crowded bands.

Visit your Dealer soon and examine the great new LOUDENBOOMER MARK II LINEAR AMPLIFIER.

HERE ARE A FEW OF THE MANY MODERN FEATURES:

1. Zero-bias Eimac 3-400Z requires no screen and grid power supplies. 400 watts of plate dissipation.
2. Full legal input power on CW and SSB, 600 watts AM —80 through 10 meters.
3. 45 watts of drive for full input.
4. Grounded grid circuit for improved linearity. No neutralization.
5. Fully metered for grid current, plate current, plate voltage *and* relative power output.
6. 50 ohms input through wide band Ferramic transformer.
7. Adjustable Pi tank output; nominally designed for 50 ohms unbalanced load.
8. Requires just one power supply—2500 to 3000 VDC at 350 MA.*
9. Circuitry supplied for controlling power supply from MARK II panel.
10. 50 C. F. M. blower and self-contained filament transformer requires 115 VAC, 60 cycles. Both front-panel fused.

*NOW AVAILABLE: Matching Power Supply for the MARK II Linear Amplifier. Supplies 3000 VDC at 350 MA Continuous. Transformer Primary for both 115 VAC and 230 VAC. Size, 12" x 14" x 8½". Weight 75 lbs. AMATEUR NET, $159.59.

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KANSAS CITY, KANSAS

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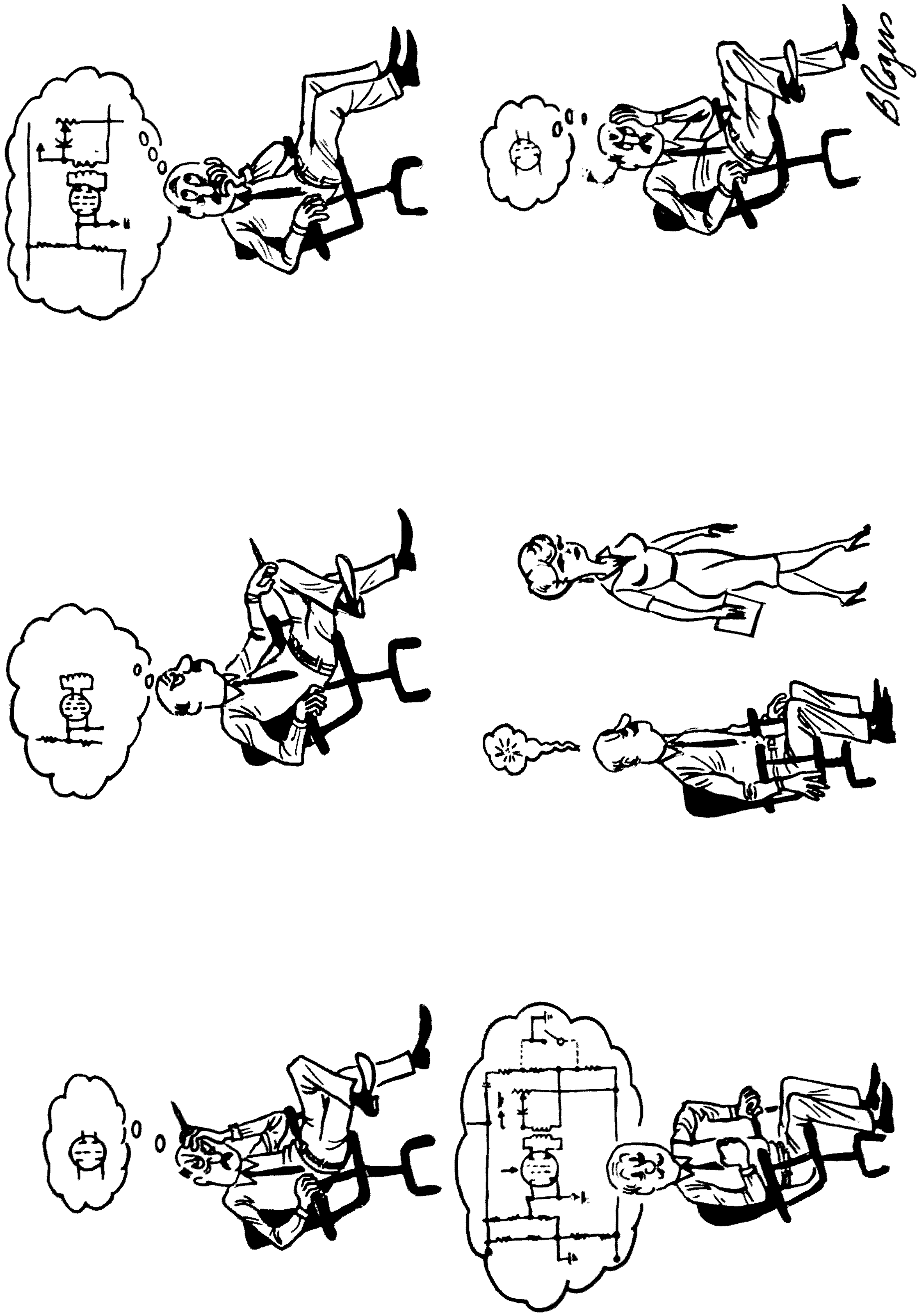

Dress Up Home Made Gear

Harvey Pierce W0OPA
5372 E. Bald Eagle Blvd.
White Bear Lake 10, Minnesota

One problem the home constructor always faces is how to finish his gear with a "professional" touch. These days many ham stations are in full view of any visitor to home, so the home builder wants his gear to look as nice as his commercially built gear. No matter how neatly made, gear with unfinished metal panels and cases looks out of place.

The usual answer is a can of enamel or lacquer, either spray or brush. But let's face it! Paint is messy, however you use it. It *always* gets onto something it isn't supposed to, and has to be removed therefrom, usually with some effort.

Why not use self-adhesive vinyl film? It is neat and clean, and widely available under various trade names, such as "Cling," "Con-Tact," "Magic-Cover," etc. It is moderate in cost, in terms of the amount used per piece of gear. (The price runs about 11c per square foot locally.) It comes in many patterns and shades, some of which are very suitable for ham gear. Let your taste guide you. If you want a plain panel, the printed pattern will easily wipe off with a cloth moistened with lacquer solvent. A look at the back (adhesive) side of the film will tell you what color you will get with the pattern removed.

Advantages of using vinyl film to cover your panels and cabinets are,—it is clean to work with, requires no drying time, covers small holes (large ones tend to show, but look better anyway covered), and can be removed and renewed any time without muss. It will give your gear the textured look now so popular.

There are disadvantages, of course. The adhesive is of the "contact" type and doesn't dry or set, so that exposed edges and corners of the film tend to curl and peel back if exposed to rubbing or abrasion. Decals do not seem to adhere to the film unless the film is coated with lacquer. Being relatively inelastic, it cannot be stretched to cover bulges, formed round cabinet corners or other compound curves.

Excellent results can be obtained by following a few general rules besides those that come with the film. First, remove all burrs from holes, especially those you wish to cover and hide, and round off all sharp edges that might cut through the film. Second, clean the surface to be covered thoroughly of grease, oil, dust, and chips, as grease will weaken the adhesive and even a tiny particle will make a visible "pimple" if trapped under the film. Third, fold over at least ¾ inch of film at all edges. Fig. 1 shows how to cut and fold the film around the

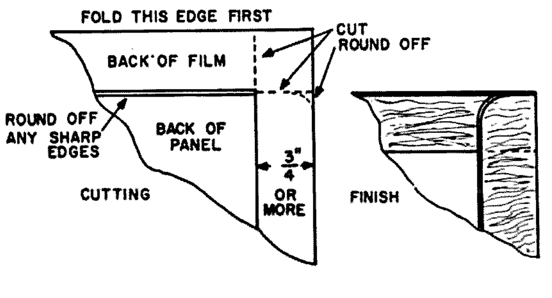

FIG. 1

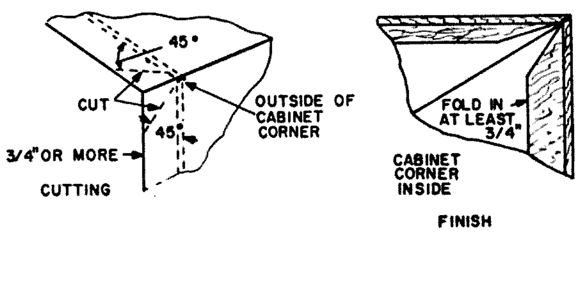

FIG. 2

edges and corners of a panel or other flat sheet. Note that the corner folded on top is rounded to prevent curling. Fig. 2 suggests how to treat an open cabinet corner. Fourth, keep your fingers clear, as any dirt or grease on your fingers will weaken or even "kill" the adhesive where you touch it. Fifth, on all but small pieces remove the paper backing from the film as you smooth it on. It is easier to avoid air bubbles and wrinkles this way, and the adhesive has less chance to pick up dust and dirt.

While holes can be drilled after the film has been applied, it is better to have the holes all drilled before covering. Small holes can be opened thru the film with a sharp awl or icepick or larger ones cut thru with the point of a sharp knife. Be sure to use smooth washers under all screw heads and nuts, to avoid drawing and wrinkling the film while tightening them. Ventilating holes should be finished with eyelets as it is impossible to put a small clean-looking hole thru both film and backing.

In removing the pattern to obtain a plain film, be very careful with the lacquer thinner. Do not apply it to the film directly, but moisten a small pad of cloth and rub on a small area at a time and allow to dry immediately. Do not let the solvent get to the adhesive backing, as through a hole or slit, and do not permit the film to stay wet with the solvent. Be sure you have adequate ventilation, and DON'T SMOKE!

Because this vinyl film is as easy to remove as it is to apply, you can experiment to your heart's content with two-tone combinations, different patterns, and so on. Don't overlook the possibilities of various decorative tapes, foils, and adhesive letters. Maybe you can't quite equal the spraybooths and silk screens of the manufacturers, but you can certainly improve the looks of that bare metal panel and box, and without muss, too. . . . W0OPA

Find the Common Ground

Dick Baldwin K4ZQR
409 Kaelin Dr.
Louisville 7, Ky.

It was in March of 1960, and the sun spots had not slid down the slope of cycle 19 quite so far as they have now. I had tuned the Valiant up around 21300 kc and called CQ DX with the beam toward Europe. I announced that I was listening, first on my frequency, and then in the foreign part of the band. Nothing unusual about this—a routine DX call on a Saturday afternoon. Little did I realize it would or could culminate in a friendship that has grown over the months and has done its bit, I hope, toward contributing to international good will.

To get on with the story, I got an answer on my frequency, and of course, it was a constant battle with the stateside QRM to make out even the call and the handle. It turned out to be I1BAK whose handle was Giuliano in Rimini, Italy; and for a few minutes we had the frequency clear—long enough for Giuliano to find out I was using a quad antenna and to tell me that he was using one also, and would appreciate some help on its dimensions and tuning. Maybe it was the quad that established the common ground between us, or maybe it was the fact that here was a chance to do something besides exchange RST's and QSL's, but after we signed I made a copy of some of the Handbook text on quads, described and diagramed my own setup and enclosed it with my QSL.

Back came a letter of thanks and a request for the mailing of an Heathkit Grid Dip Meter, an instrument which he could not purchase in Italy. I said okay and he sent the money in advance through a New York bank. During the past year we have corresponded regularly, and every once in a while I'd mail him a bit of surplus—a relay—a tube—or some small part I didn't need and he in turn would send us a piece of handicraft—perhaps a box or a tray, since Italy is short on electronic gear but long on the arts.

Of course we made schedules, but only one other resulted in a contact and that was brief. Either the QRM moved in or the band shifted,

never a solid contact after that first one.

Through the mail, however, and by means of some tapes we exchanged; we got well acquainted with each other and our families. Giuliano is an electrical engineer with the equivalent of a Ph.D. in engineering. He works for the Italian State Railways. Me, I'm at that stage in life when the children are married and you begin to wonder if you are ever going to get back to Europe to see what has happened since the War 20 years ago. We couldn't really afford it, but the XYL and I decided to go while we could still navigate without crutches and before any more shooting started. I was going to show her Paris, London, and all those far away places she had heard me tell about these many years.

With three weeks of vacation we decided the best bet was a canned tour. Even though it wouldn't retrace all of the route I'd taken with Patton's Third Army, I could still show her London, Paris, Luxembourg, and parts of France and Germany. Italy, too, was on the tour and while I had seen no part of it while in the service, we got an unexpected dividend in the form of an overnight stop in Rimini—the home QTH of my Italian friend. My wife was all smiles as she told me this as I came home from work the evening after the itinerary of the trip arrived.

This was in March of 1962 and our day in Rimini was not until August 19th, almost five months later; but I could hardly wait to send off an air mail to Giuliano and tell him we would have an eyeball QSO in August. He practically went into orbit and told us to arrive "destitute" (he meant hungry) as we would get a "stuffing."

Finally the big day came. I had written that we should arrive in Rimini about 4:00 pm in the afternoon. Actually we got in about 3:30 pm and after freshening up we came down to the lobby of our hotel at 3:55 pm to phone my friend. He and his wife were waiting there for us because we had a scheduled meeting at 4:00 pm!

What did we want to do? The town was ours. Well, first of all I said I'd like to see his shack and of course this pleased him just as it would please any other ham, here or abroad. Italians have a tough time acquiring equipment. Only one firm, Geloso, makes amateur equipment and while their stuff is excellent, it is limited in scope to VFO's and receivers, and it is not cheap. You can buy Heathkits over there but at fantastic prices. He had an AR88 for a receiver, and a transmitter constructed from a Geloso VFO and parallel 6146's that I'd sent him. We discussed mutual

problems for a few minutes and then the XYL's broke it up by suggesting we go for a drive around Rimini.

We wound up in San Marino, which is a tiny republic surrounded by Italy on a mountain top. It's one souvenir shop after another, and while there I met MID, the only ham in San Marino and Giuliano's first contact as a ham. He is no longer active or I would have made a schedule then and there as I could use another country toward that DXCC.

Back to Rimini for the "stuffing" which consisted of the Italian equivalent of a New England Shore Dinner. Rimini is on the Adriatic Sea, and the fish is excellent, especially when eaten in a romantic restaurant where the ceiling is a grape arbor and where you wash down each course with the juice of the grape.

Finally it was time to part, and we took our presents and said goodby as they dropped us off at the hotel. Of course we gave them presents too; some nylon things for his XYL, a doll and dresses for Monica, his daughter, and some radio parts for Giuliano. As for our gifts, we now have a beautiful miniature marble statue of Pauline Bonaparte (Napoleon's sister) on our mantle, a pair of beautiful gold frame 17th century style pictures on the wall, and one of the best bottles of after-dinner cordial I ever tasted safely stowed down the hatch. Plus, of course, the best gift of all—the fond memories of an evening spent in cementing international relations that neither the XYL nor I will ever forget.

The XYL, normally no more enthusiastic about ham doings than any average XYL, remarked afterward that she wished we had other spots on our tour where we could visit hams I'd contacted. Hmm—maybe I should have written that French ham I sent a copy of "My Old Kentucky Home" to on request.

DX contacts are brief and often difficult, but find the common ground if you can; whether it be your gear, families, work, hobbies, or what have you. Find it—and you find a friend, not just a contact. . . . K4ZQR

Controlled Carrier Screen Modulation

Terrence Banks K3LNZ
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Washington 20, D. C.

One of the problems confronting either the home constructor or the kit or commercial equipment buyer is the recent popularity of the controlled-carrier method of screen-grid modulation. Judging from the on-the-air discussions I have heard about this system, some of the basic facts are being ignored by those interested, either pro or con, and the advertising claims of several manufacturers serve only to add more confusion to the issue. It is the intention of this article to present the basic facts in such a way that they can be considered minus the prejudices and misconceptions usually brought up.

First, let's set our ground rules so we will know what we are talking about and, equally important, what we are not talking about. By screen modulation we mean only the controlled carrier variety. Without this feature, screen modulation requires much larger tubes than would normally be used for the same power level, and is best left for those with large tubes and small power supplies. By plate modulation we mean the standard transformer-coupled modulation of the plate (plus screen grid in tetrodes and pentodes) of a Class C final amplifier. Linear amplifiers, sideband, etc., are not under discussion. Neither is audio quality which Heath and several other companies have proved can be excellent with screen modulation.

Let us use the popular type 6146 tube as a guinea pig. We will supply adequate grid drive and run 600 volts on the plate. First we will take a typical set of screen-modulated conditions, and then will compare the corresponding maximum ratings with plate modulation. We will then discuss the relative output obtainable, the ease and economy of applying the two methods, and finally some operating considerations.

Power-wise, most manufacturers will rate their 6146 transmitters as "90 watts input on CW and 90 watts peak input on phone." Trans-

lated into English, this means that the maximum plate current readings obtained on voice peaks are equal (150 ma) to the key-down CW conditions. However, no meter yet produced will keep up with the variations in the human voice, so meter readings of 150 ma actually mean that the peaks are running in the neighborhood of 250 ma, or about 70% higher. This is about the highest they can run without the opposite peaks driving the screen so negative that cut-off of the tube (and therefore splatter) occurs. Presuming peaks of 250 ma and the opposite peaks of slightly above zero, we have an average input to the final of about 125 ma, which at 600 volts will give us 75 watts.

In a plate modulated final, the meter will read a steady 112 ma for the maximum rated phone input of 67½ watts, whether modulated or not. However, the secondary of the modulation transformer will have an audio (ac) voltage across it, and therefore in series with the dc plate supply voltage, exactly equal to our 600 volt plate voltage. This gives us a voltage varying from zero to 1200 volts. We assume the modulating impedance, which is the combined resistance of the final tube, tank coil and other circuit components, to remain the same (about 5500 ohms) so our plate current actually varies from zero to double the average meter reading. This gives us peaks of four times the unmodulated input, as the voltage and current both double at the same time. 67½ watts times 4 is 270 watts on peaks, which would make us think the average input is one-half of that, or 135 watts. Due to factors we won't discuss here, this is not the case and the average power input under these conditions is about 37% of the peaks rather than 50%. We could prove this mathematically, or by instruments, but it's simpler to add our dc input to the final, 67½ watts, and the audio power supplied by the modulator, or about 33 watts, which gives us an average input under modulation of just over 100 watts. Thus we see that our input, and therefore output, is about 33% higher (100 versus 75) when using plate modulation instead of screen modulation with the same tube.

Turning next to ease and economy of construction, we find that a 6SL7 speech amplifier and 6SN7 modulator will handle our 6146 quite easily. Other components required are small and few, so on a 2 x 4 minibox we can build, or purchase, a suitable screen modulator for about $12.00. If our transmitter cost us $50.00, we pay 82c per watt of input.

A plate modulator for the same rig will use 2 6L6 or larger tubes, plus speech amplifiers,

a driver stage, interstage transformer, modulation transformer, and a power supply at least as large as the transmitter uses. On an 8 x 10 chassis we build, or buy, a modulator for about $40.00 and pay 90c per watt of input power.

However, if we add the other accessories necessary to put the transmitter on the air, such as microphone, crystals, antenna, etc., we find that as soon as our accessories reach a total of about $45.00, our cost per watt becomes equal for either type of modulation and then proceeds to favor plate modulation from this point on.

Finally, we come to operating factors. The difference between a 75 watt transmitter and a 100 watt transmitter is approximately one-third of a unit on the S-meter, so for good band conditions or local work, there is no appreciable difference. However, under weak signal conditions the steady carrier of the plate modulated transmitter pays off slightly better. This is because the controlled-carrier type of signal will drop off and allow bursts of noise to intrude between syllables, making copy difficult. There is also the minor, but nonetheless present, inconvenience of having to put the screen modulated transmitter in the CW mode for tune-up, whereas it is quite feasible to zero-beat an incoming signal with the VFO only and then dip the final of the plate modulated transmitter while calling.

In conclusion, the screen modulated transmitter is neither the monstrosity its opponents claim, nor the low-priced powerhouse its advocates would have us believe. It sounds well, is simple and economical, and gets almost, but not quite, as much signal out of a tube as plate modulation. For the amateur who does not have money to throw away it represents an excellent means of getting a phone signal on the air with little investment, and can then be put aside for emergencies, sold, or dismantled for parts when plate modulation is later installed as an improvement.

A Compact VFO Dial

Roy Pafenberg W4WKM

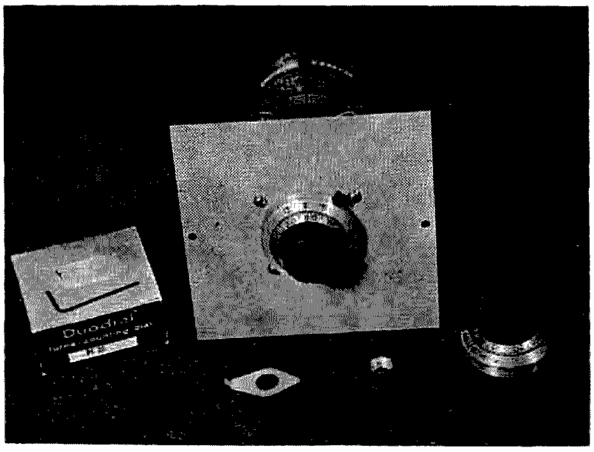
Many amateur applications require a reasonably compact, multi-turn dial with a high order of accuracy. Typical control problems include rotary inductors, variable vacuum capacitors and permeability tuned oscillators.

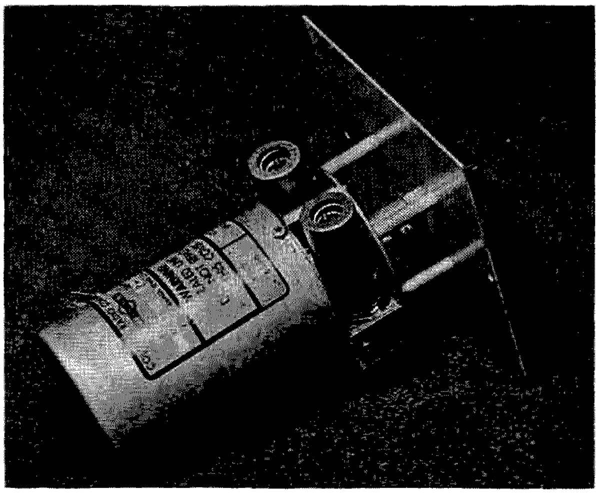
One answer exists in the wide variety of precision multi-turn potentiometer dials that are available. These dials are attractive, compact and provide excellent accuracy. Their use is particularly desirable in miniature portable and mobile equipment.

A typical installation is shown in the photographs. The Collins 70E-15 PTO unit is mounted on the panel using standoff posts. A ¼" extension shaft is installed in a panel bushing and a solid coupling used to secure the PTO shaft to the extension. A Beckman Helipot type RB turns counting dial is then installed. The dial consists of two parts as shown in the photograph. The dial retaining clip is secured to the panel with the special ⅜" bushing nut. The knob proper is positioned over the clip and held in place by the knob set screw.

This dial, being direct driven, is free of backlash and provides direct reading calibration of the PTO over its 1 mc range. In the application shown, the PTO will be employed in a universal exciter with a basic range of 3 to 4 mc. A wide selection of these dials is available and almost any multi-turn control problem may be solved by their use.

. . . W4WKM





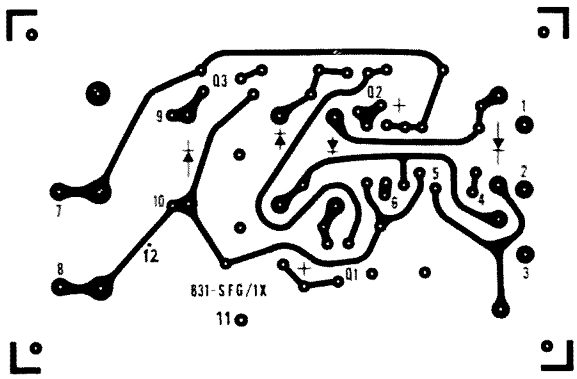
A Simple Procedure for making Etched Boards

Charles Miller W1ISI
General Radio Co.
West Concord, Mass.

Etched-circuit boards first made their appearance about 1952. Many improvements in materials and techniques since that time have led to their general acceptance throughout the electronics field. Industrial electronics manufacturers have accepted them for a variety of reasons. On a small-volume basis, etched circuits provide uniformity and freedom from wiring errors. An added advantage in large volume is reduced cost. The initial cost of the board is low and it lends itself admirably to automated assembly. As the necessary materials became increasingly available, etched circuits began to appear in construction articles. Although ready-made boards are occasionally available for such projects, it is usually left to the reader to duplicate the board.

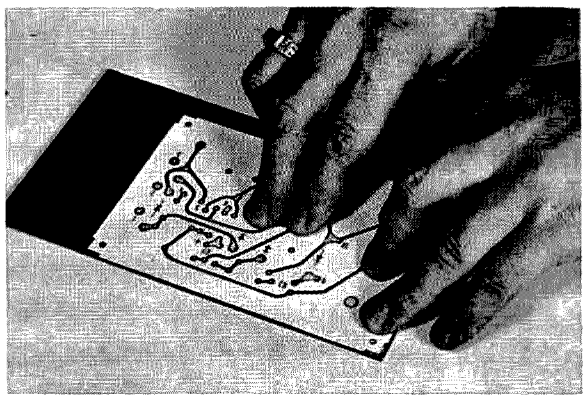
Before one starts to make an etched board, he should first determine if an etched board is really necessary. Two factors are involved. The first is circuit complexity; the second is the extent of the available facilities. A simple circuit may be assembled more rapidly by means of conventional construction techniques. Complicated boards or boards with high parts density should be avoided unless the equipment is available to reproduce them photographically. On moderately complex boards, a technique described in this article may be used. This method is simple, fast, requires only a few, long-lasting, special materials, and offers very good results.

The board should be made from a full-scale layout of a proven circuit. This may be taken from a construction article or it may be something of your own design. It is important, however, that the hole spacings be precisely those required on the finished board. The materials shown in Photo 2 are basic to laying out the board. The copper-clad laminate, the resist and the etchant are the only special materials required. Precut laminate is available in various combinations of size, thickness, and material. The etchant shown is a powder and comes with full instructions for mixing. The resist may be purchased in a collapsible metal

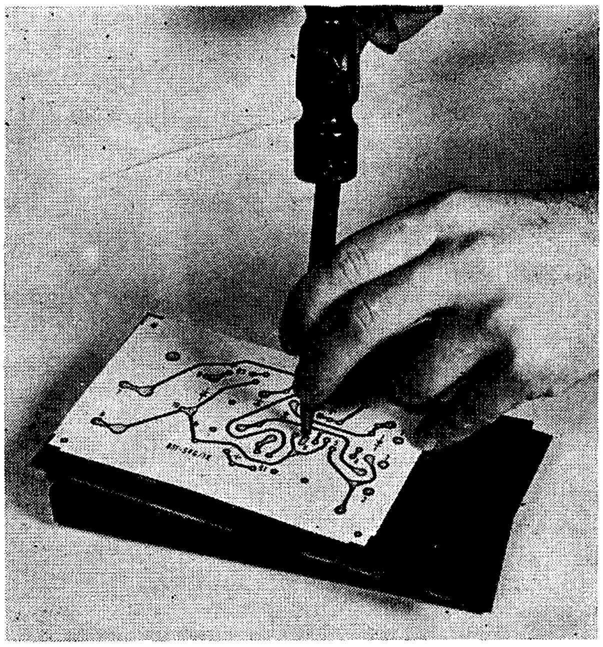


1—Typical etched-circuit board.

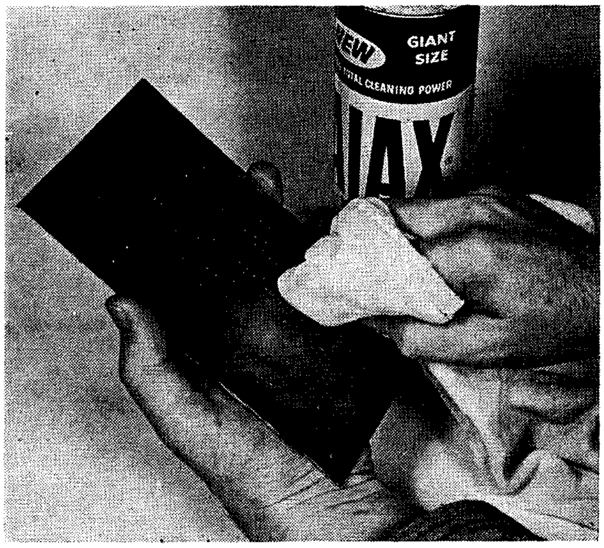
2—Basic materials required. The tubes contain rubber cement and liquid resist, the packet contains etchant.



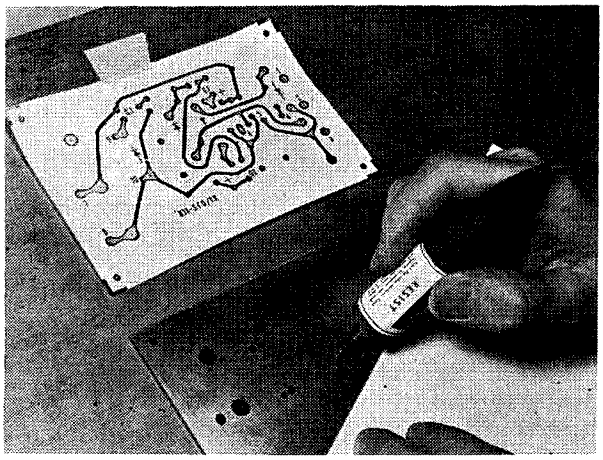
3—Trim the pattern to size. Apply rubber cement liberally to back of pattern and bond it to the copper side of the laminate.



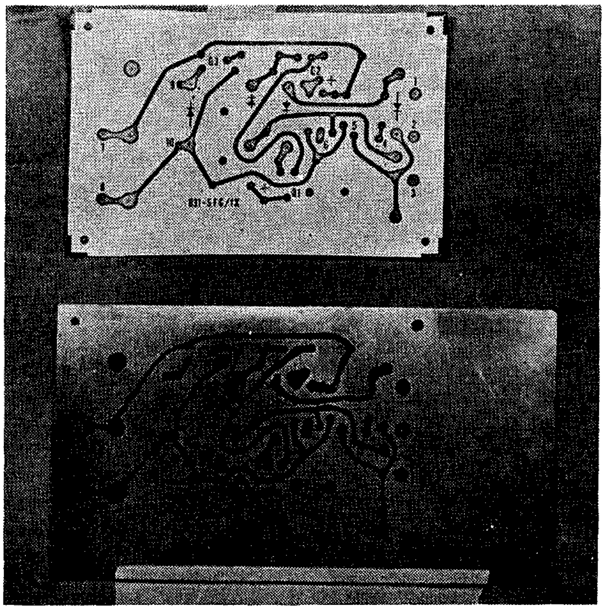
4—Allow to dry, then lightly punch the centers for holes to be drilled later.



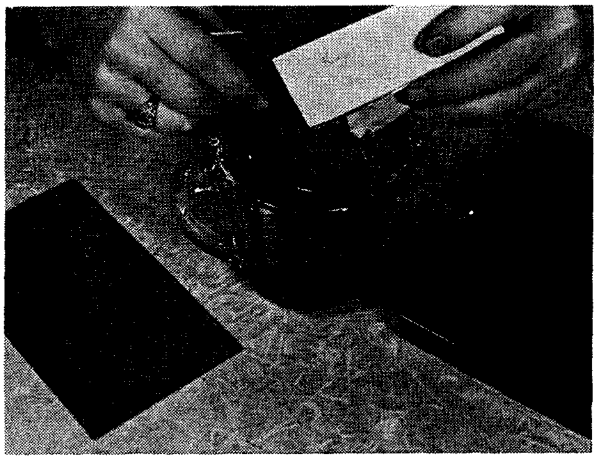
5—Carefully peel the master from the copper and save it. Remove all rubber cement from copper, then scour thoroughly. Avoid touching copper surface from now on.



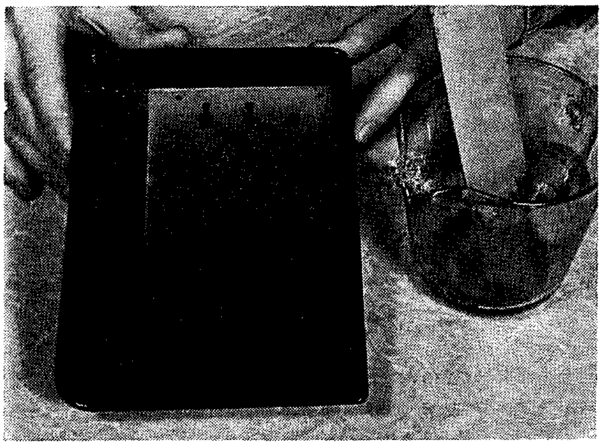
6—Punched centers provide convenient starting points for resist. 'Pads" should be drawn first to prevent crowding. Original layout is used as a guide.



7—The conductors are laid down and the resist allowed to dry thoroughly.



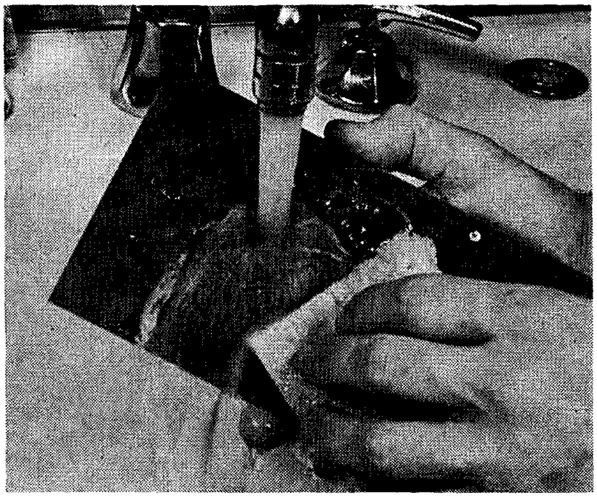
8—Etchant is mixed according to directions. A Pyrex container must be used for safety.



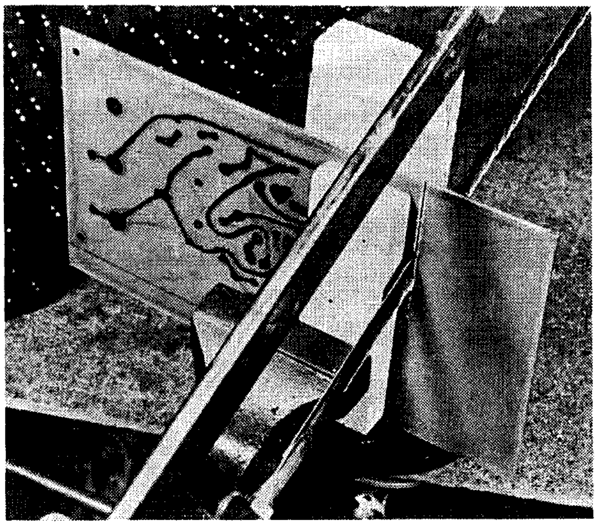
9—A shallow glass or plastic tray should be used to avoid contamination of the etchant.

tube tipped with a ball-point assembly. These materials are available from most of the larger electronic supply houses.

It is extremely important that the copper surface be thoroughly scoured with cleanser to remove any contamination. Fingerprints are particularly difficult to remove and if the cleanser fails, it may be necessary to use a very fine grade of steel wool. A uniform, high lustre must be obtained to ensure both proper adhesion of the resist and proper etching. Photos 6 and 7 illustrate the application of the resist Due to the spacings involved in the example, the pads are first laid down over the centers. The conductors connecting various pads are then drawn in with little difficulty, starting from the center of the board and working toward the outer edges. To correct mistakes, dried resist may be scraped off with a model knife or carbon tetrachloride on a cotton swab may be carefully applied. When mixing the etchant, be sure to follow the instructions. If a Pyrex tray of small size is available, both the mixing and the etching may be done in the tray. During the etching, the tray is rocked gently back and forth and from side to side so that the displacement of the copper proceeds uniformly at all parts of the board. Even so, etching may proceed more slowly in some areas than on the rest of the board. Rubbing these areas with a cotton swab will increase the rate. Once etching is complete, the board must be thoroughly washed to remove every last trace of the etchant. These traces could react with the humidity in the air to cause etching of the conductors themselves. The resist material should not be removed until the board has been cut to size and is actually

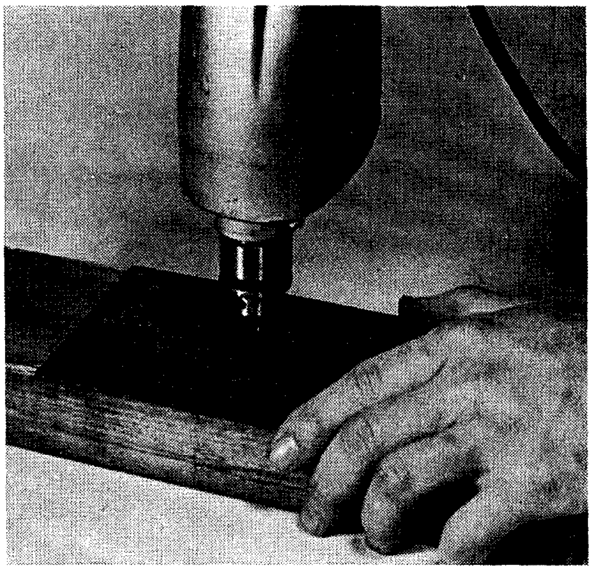


10—Board is removed immediately when all excess copper has been removed, and is thoroughly rinsed to eliminate all traces of etchant.

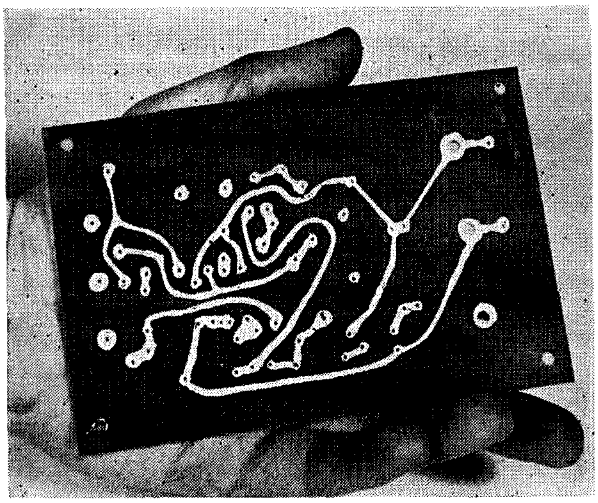


11—The board is marked, then cut to size. Soft wood blocks prevent damage to conductors.

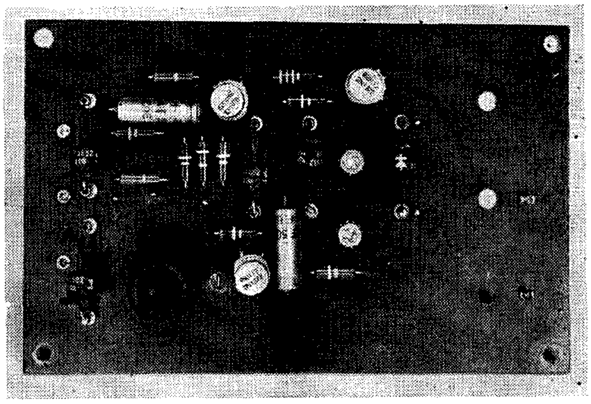
12—Resist may be removed with carbon-tetrachloride. Cleaning should continue until rag shows no trace of resist; otherwise difficulty may be encountered in soldering.



13—All centers are drilled with smallest-size hole required. This provides pilot holes for larger drill sizes.



14—Finished board ready to accept components. After assembly, conductors should either be tinned or coated with clear acrylic spray.



15—Top side of assembled board.

ready for use. It serves as an excellent protection for the copper surfaces beneath it. Removing the resist exposes not only the conductors but also the centers punched in Photo 4. The author prefers to use the drill required for the smallest hole in the board as a pilot drill. This simplifies the task of keeping the holes where the punch marks are. The pilot holes are then drilled out to larger sizes where required.

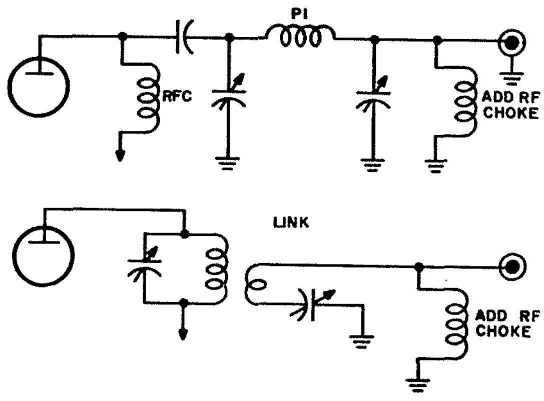
Once the board is finished the components should be mounted. The components are normally mounted on the side opposite the conductors. Their leads are inserted in the appropriate holes, bent slightly to keep the components in place, then clipped. The board should be checked to be sure that the right leads are in the right holes, proper polarities are observed, etc. Extreme care must be taken not to overheat the conductors during soldering, as this will cause them to release from the board. A 25-watt pencil-tipped iron will supply enough heat to make good solder joints quickly. The circuit should be tested electrically to ensure that it functions properly. Then the conductors should be given a coat of clear acrylic spray, such as Krylon. If this is undesirable, each individual conductor may be tinned by sliding the iron from one pad along the length of the conductor to the next. This must be done quickly, feeding solder to the tip as required. . . . W1ISI

Oversight

Harvey Hurwitz WA2HYS

It was a quiet evening in the shack, a gentle murmur of the QRM came from the Old Hearing Aid and the time had come to fire up the rig. After dutifully waiting for the filaments to heat, the key was depressed. Lo and behold, though the plate meter kicked up to maximum, yet there was no output. The best thing to do was to get out the dummy load and see what was wrong. After carefully removing the co-ax connector to the Gamma matched beam, you start to connect the dummy load. As the center pin on the load cable touches the center pin of the antenna socket there is a flash. A thirty-six cent oversight has claimed another victim.

If you think that this can not happen to you, you had better get out that old schematic and take a long careful look at same. Examination of a large number of popular transmitters has uncovered a built in booby trap. It is entirely possible for a great number of both low and high power transmitters to have the full B plus potential present at the antenna jack. All that is required is the breakdown of a coupling capacitor or a minor shift in the position of the link coupling. Unless your antenna presents a dc short between the center conductor and the shield, the only indication that



TYPICAL OUTPUT CIRCUITS

something is amiss will be the loss of output power. If, as you properly should, you have turned off the power before changing cables only the dummy load will suffer. On the other hand if you simply reach behind the set and pull the cable out, burned hands are the very least that you can expect.

The concept of "Fail Safe" construction is one of the basic criteria of effective design. I regret to say that many of the transmitters being produced today, both in factories and "home brew," have neglected this item. This problem has been found to exist in transmitters ranging from a few watts to a kilowatt or more.

Now that we have outlined the results of this oversight, let's get busy and eliminate the problem. Examine the final output stage on your schematic. If it is a Pi network, you will note a coupling capacitor, a tuning capacitor, a coil with associated band switch and a loading capacitor. One end of the coil will be connected to the antenna jack. It is probable that you WILL NOT find an rf choke running from the antenna jack center pin to ground. This thirty-six cent item could mean the difference between life and death. It has no effect on rf output, yet provides a path for dc to ground. It is commonly called a Safety Choke. In the event of a breakdown in the coupling capacitor, this choke will promptly blow the fuses by shorting the dc plate potential to ground.

If on examining your schematic you find that your transmitter utilizes link coupling, DO NOT assume that the unit is safe. It is not at all unusual for the insulation (if any) on the link coil to break down, or for the link assembly itself to come in contact with the tank coil or plate lines. Virtually all transmitters using link coupling have a load capacitor at the ground end of the link. This capacitor has the effect of preventing dc from shorting to ground. In this respect you can see that both Pi network and the Link coupled stage are alike. The cure is the same. Install the missing Safety Choke. The nominal value of this choke is 2.5 mh with a current rating of 200-300 ma.

It may be of interest to note that among the worst offenders are VHF transmitters using variable link coupling in association with plate lines.

To say that the power supply should be turned off before attempting any adjustment is naturally correct, yet it appears quite foolhardy to trust your life to a simple switch or relay. It is far better to blow the fuses or even have a bit of smoke than to chance sudden and efficient oblivion. . . . WA2HYS

de W2NSD

Never say die

IoAR

This is the last month that anyone can join the Institute with the plan of going on the ham flight to Europe in October for membership for six months previous to the flight is required by airline regulation.

As of this writing the reservations are starting to come in. Everyone on the 73 staff, possibly more infected by proximity with my enthusiasm than most readers, wants to go. We are arranging for fare-protector insurance which will protect anyone who finds that he is unable to go on the trip by reason of some unforseen dilemma.

We are going to have a ball, so come on along. The price for the round trip by jet plus air transportation throughout Europe plus hotel accommodations and breakfasts will be about $550 per person. This is what I paid just for my plane fare to Paris and back, so you can see that by traveling in a group we are able to realize some economies. Send $250 per person for a reservation. The trip leaves Idlewild October 6th and returns October 27th. We'll be visiting London, Paris, Geneva, Rome and Berlin. Don't miss it.

Grrr

Try this one on for size. You've just spent three years working the clock around for no salary in an attempt to build up something that you believe in, something that you want desperately to succeed. Then, all of a sudden, something completely beyond your control goes wrong and all of the good will that you've tried so hard to build up is hopelessly and perhaps forever damaged.

Now, as I try to piece together the hundreds and hundreds of delayed and even lost subscriptions, I wonder at the laws of our country that prevent me from what I could easily convince myself would be a case of completely justifiable homicide. I guess I am too easygoing. I kept believing the fellow who had contracted to operate our subscription stencil department. I believed him when he told me that he was only a little behind. I believed him when he said he was answering all complaints upon receipt. Then, after I no longer believed him, it still took over a month before I could locate the machinery necessary to do everything up here and to hire the girls to handle it.

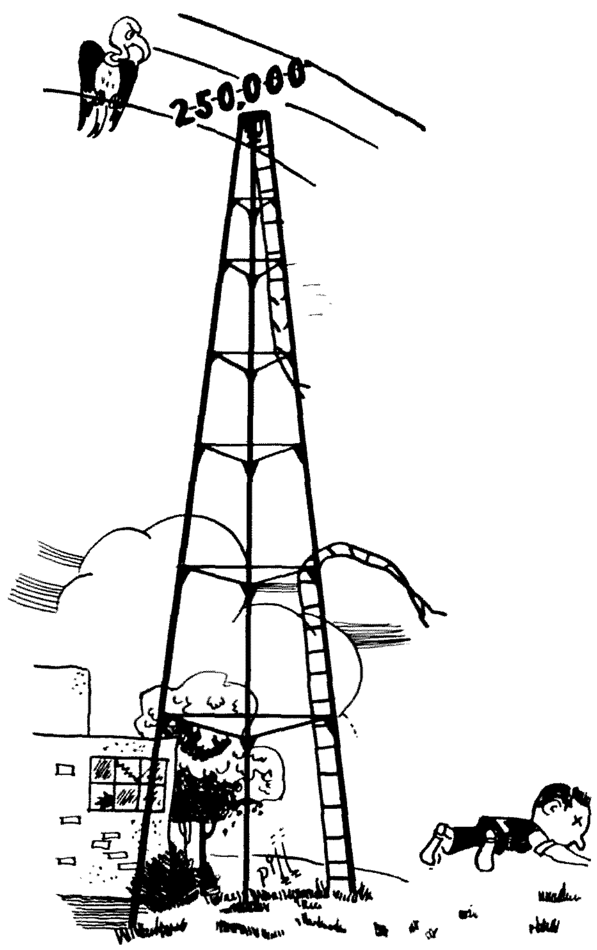
The apoplexy really set in when I got everything up here and found that all of the complaints were still in unopened envelopes. That just about did me in. Fortunately most of our subscribers are very forgiving. I am straightening things out as fast as I can. I've been up night after night working on all of the complaints.

In spite of the rather shoddy deal that many subscribers have had, only a few fellows have been nasty. I wish I wouldn't react so violently when they do write in and accuse me of being a crook. Somehow these incredible idiots have convinced themselves that the magazine is just a front I have used so that I could personally gyp them. When I finally cool down (after writing about six letters which I sure wish I could mail), I realize that many fellows go through life just looking for things to be mad about. I am just getting a little taste of what their family and co-workers have to put up with every day. It isn't necessary to be nasty . . . and it serves no useful purpose. My word, I've just waited eight weeks for my subscriptions to start to *National Review*, *Analog*, and the *Scientific American*. I've waited over

(Turn to page 116)

Institute Membership Drive

Frankly we were just a bit disappointed with the February showing. Let's put that old shoulder back to the grindstone and see if we can't get the membership drive back on the tracks and aim it at going over the top. There are a great many important reasons why you should bend your every effort at making this great membership drive a tremendous success. You know what most of them are so we don't have to go into all that over and over again. While on the subject, we want to ask those amateurs who have been critical of the Institute to please mind their own business . . . if they want to grumble they should join first, like all the other members. We would also like to lay to rest the vicious rumors that the reason we are aiming at a membership of 250,000 is that our printer mistook our order for 2500 membership cards and printed 250,000 instead. This did happen, of course, but there is no connection whatever between that little accident which could have happened to anyone and our drive for the same number of members.



(almost) All About Sideband

Staff

Unlike the weather and Mark Twain's comments thereon, almost everybody does something about sideband but hardly anybody ever talks about it.

The die-hard AM-er turns it off. The fervent mono-sidebander won't talk to the double-sideband boys, CW addicts either ignore it or dive enthusiastically into the middle of the mess. FM enthusiasts chuckle knowingly up their sleeves.

Yep, almost everybody does something about it. But the absence of talk *about* sideband leaves the newcomer in a somewhat confused position. His best friends don't tell him—frequently, because they haven't been able to dig through the mathematics of it either.

Oh, quite a few feet of paper have been expended in articles telling "all about sideband" before. And a few inches of this mass have told, in easily understood language, just what it is and how it works. But the conventional approach to talking about sideband so far seems to have been to begin with a discussion of vectors.

Vectors, in case you never met one, are imaginary little arrows with pointed heads which revolve in a multitude of directions while you're talking on a sideband rig. Since any discussion or "explanation" via vectors tends to leave most everybody else going around in circles too, we'll not be meeting them in this discussion.

What we *will* be doing is to examine in detail the various things that go to make up sideband.

When you look into the schematic of a typical modern sideband rig, the usual reaction is "ohmygaws! !" But it's not really all that complicated. The basic circuits themselves are simple enough, and most of them appear both in transmitters and receivers (a most significant difference from AM, CW, or FM). The thing that makes it look so horrible is simply that most of the circuitry is somewhat unfamiliar to most of us.

So, as we said earlier, we're going to take some detailed looks. In subsequent articles, we'll explore modulators, ways of disposing of the unwanted sideband (and why it's unwanted, poor orphan), linear amplifiers, instrumentation, measurement and alignment, power supplies for sideband, and finally the systems approach. The general format will follow that of our earlier series of technical articles, in which all common and many uncommon circuits filling a specific function were examined in detail, complete with circuit analysis and listing of pros and cons for each.

Before getting into all this circuitry, we have to start someplace. And the logical starting point is with the signal itself. Just what *is* sideband?

(Old-timers and sideband addicts, we're sure, will excuse a repetition of the basics they learned long ago. But they might find the approach we're using of interest, since it's not quite the same as that used in most handbooks.)

The first essential to getting a true understanding of just what sideband consists of is to find out what AM really is.

Let's back off to receiver theory a minute and consider the mixer in a superhet. This is a stage which receives two input signals, each at a different frequency, and puts out four output signals (if it's a good mixer). These output signals are the two original ones, the *sum* of the original signals, and the *difference* of the original ones. Clear, no?

Explaining in detail just how this happens is a bit beyond the scope of our approach, since to do it right takes several pages of calculations which would make vector analysis look easy by comparison. But in essence, whenever two signals are applied to a non-linear device (engineeringese term meaning any circuit element which distorts its input signal), you'll get the four signals out. Sometimes more. Or in other words, any non-linear device becomes a mixer automatically if you put two input signals into it.

Now, there's hardly anything that distorts the input signal more than a conventional Class C rf amplifier. It takes a perfectly good sine wave signal and turns it into a series of spike-like pulses. Very non-linear.

So when you feed one signal (the carrier) into the grid circuit, and another signal (the audio) in at the plate, you automatically get mixing action.

This means that if you take a 3900-kc rf carrier and apply a 2-kc tone to the audio, your output should consist of 2 kc, 3898 kc,

3900 kc, and 3902 kc.

And if you try that experiment, you'll find out that this is precisely what happens (if you use a sharp enough receiver to examine the output).

The 2-kc signal gets lost in the tank circuit, naturally, but the other three all go out to the antenna. They journey around a bit, eventually hit somebody else's antenna, clamber down the feedline, and enter his receiver. Once there, they go through another mixing process, through the *if* strip, and come face to face with a diode "detector."

If there's any other circuit element which distorts things as badly as a Class C amplifier, it's an unbiased diode. So let's look at just what happens in the "detector."

Remember, we're talking about *three* signals which left your transmitter, not just one. They all three hit the diode at the same time—and you might expect to get six output signals: 2 kc, 4 kc, 2kc, 3898 kc, 3900 kc, and 3902 kc.

Actually, because of some rather involved phase consideration, the 4-kc signal (beat between 3898 and 3902) never shows up. The three high-frequency signals get lost in the output circuits just like the audio disappeared from the transmitter output.

And what's left? The 2-kc tone we started with!

The object of all this is to point out that modulation and detection are really the same thing, and both are a mixing type process. For simplicity, let's just call it all "modulating" from here on in.

Now, what we've been talking about so far has been standard AM. But we had to find out the *real* way it works before we could go into the sideband situation.

You'll remember (from a few paragraphs back) that when we started with a 2-kc audio tone, we got two "side" frequencies by modulating action.

But speech doesn't consist of just one tone. In fact, recent research has cast considerable doubt on the idea that speech consists of sine-wave tones *at all!* For our purposes, though, we'll keep on pretending it does consist of a number of tones ranging from 300 to 3000 cycles per second. Such a group of tones is called a band, and the two "side frequencies" become two "sidebands" on the AM signal.

A little thought will show you that each sideband is a mirror image of the other, no matter what the modulating signal. If the audio tone at any one instant is 300 cycles, one side frequency will be 300 cycles *more* than the carrier frequency while the other will be 300 cycles *less*.

Thus, when we talk into a regular AM rig we shoot out into the ether a signal composed of three distinct parts: a carrier, which serves only to be modulated and produce sidebands, and to make the second modulating process at the receiver detector simple; an upper sideband containing all the audio tones but transposed into the *rf* spectrum *above* the carrier; and a lower sideband, identical to the upper one but lying *below* the carrier frequency.

Extensive engineering calculations, measurements, and tests have shown that to properly transmit 25 watts of audio, in both sidebands, the carrier power must be at least 50 watts. This produces a 75-watt output signal, containing 25 watts of transposed audio and 50 watts of carrier. For 250 watts of audio, 500 watts of carrier are required. And 1000 watts of carrier can handle only 500 watts of audio.

So with a full gallon, you send only 500 watts of audio—and this is composed of two identical halves, so in reality you're able to send only 250 watts of intelligence; the rest just goes along for the ride.

If you could get along without the carrier, you would come up to 1,000 watts all for audio—or 500 watts of intelligence, an instant doubling of true communication power.

But the two sidebands are mirror images of each other. Could one of them be left off without hurting anything? The answer, of course, is a resounding "Yes!" The result is single-sideband suppressed carrier, allowing 1,000 watts of talk power, which is four times as much as the legal maximum with AM.

Of course, we never get something for nothing. The price we pay for the four-time boost in power is increased complexity in the receiver (but, strangely, the transmitter is often *simpler* than an AM rig of comparable power) and vastly increased criticalness of tuning adjustments.

But we pick up some other advantages along the way too. Getting rid of the carrier does away with the annoying whistle that's a trademark of low-frequency phone bands. And the SSB signal is narrower, allowing twice as many stations to occupy the same space without any more crowding.

Now let's go back to our original example and see what happens to it in sideband.

We started with 3900-kc rf signal and a 2 kc audio tone. Let's apply them to a special kind of modulator, called a "balanced" modulator, which has the ability to null out one of its input signals from the output.

Now, instead of *four* frequencies in the output, we have only three. By adjustment of the modulator and circuit, we set things up so the three we still have are 2 kc, 3898 kc, and 3902 kc. The one we got rid of was the carrier.

The audio will still disappear in the tank circuit, leaving only the two side frequencies to go out to the antenna. At this point, we have "double sideband."

At the receiver, when the two side frequencies get to the detector, they will beat against each other to produce a 4 kc tone.

But this isn't what we started with; how do we fix it?

In AM, the original intelligence was recovered by mixing the sidebands with the incoming carrier. The carrier has been removed now. So, let's put in a new one.

This can be done either by injecting a 3900 kc signal at the receiver front end, or by using the BFO and adjusting it to the same frequency at which the 3900 kc signal would reach the detector.

Now we get the 2, 4 and 2 kc beats as before. *If* the phase of the locally-inserted carrier is exactly the same as was the carrier at the transmitter, the complicated phasing relationship mentioned earlier will cancel out the 4 kc note, leaving only the 2 kc we started with. But if the phase is wrong (and it will be if the frequency is off even a tenth of a cycle per second!), this cancellation either won't occur at all or will be only partial.

By using a very strong local carrier, such effects can be minimized but the audio recovered will be rather weak.

It's simpler to get rid of one of the two sidebands somewhere along the way, either in the transmitter or in the receiver, so that only *one* sideband reaches the receiver's detector. There, the single sideband can modulate a local carrier to produce clean, acceptable audio with a minimum of fuss and complication.

How, you may ask, do you get rid of that other sideband?

This is putting the cart before the horse; you have to get it before you can get rid of it. Therefore, the next subject in this series will be a rather deep look into modulators. There are many types of modulators—so many in fact, that the subject will require two articles to cover them comprehensively. In the meantime, if you're impatient, contact Radio Bookshop to order some of the tomes listed in the references below and do some homework.

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ARRL Staff, **Single-Sideband for the Radio Amateur**, ARRL, West Hartford, Conn., 1954, $1.50.

Don Stoner, W6TNS, **New Sideband Handbook**, Cowan Publishing Corp., New York, 1958, $3.00.

George Thurston W4MLE
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Tallahassee, Florida

Complete Junk Box Station

For Fixed Frequency Operation

The sun-spot cycle being what it is, there's an increasing interest in 10 meters and VHF bands for short-haul communications and "local nets."

You *can* put the "big rig" on the local net, if it happens to cover the band, but if you do it this way, you miss at least half the fun and almost all the value of local net operation.

The biggest advantages of local net operation derives from the use of completely separate stations—one for the local net, the other for general hamming—and the use of a squelched receiver on the local net frequency, which runs 24 hours a day. With this set-up you can receive calls even when you aren't expecting them.

One solution to the separate station problem is to go out and buy a little transceiver, a "Communicator" or a complete separate KW rig and 75S1 receiver. The other solution is to resort to the junk box. That was the one I adopted, along with a little horse trading.

The resulting station cost not a penny of cash outlay—although I'll confess to a fairly well stocked junk box. It sports a crystal converter working into a command set for receiving, and 45 watts of screen modulated rf in the transmitter. The ground plane antenna is a "fish pole special."

No special attempt was made at compactness, since the rig is essentially a fixed-frequency job and can be tucked away out of sight, controlled entirely by the PTT button on the mike, and the af gain and squelch control at the operating position.

Since the Tallahassee Key City Net operates on 29,560 and this is also the state-wide mobile calling and emergency frequency, my rig is designed for 10-meter operation.

The Transmitter

I used an 815 tube in the final because somebody once gave me a couple of them, and I hadn't up to that time, been able to figure out anything else to use them for. Almost any suitable beam power tube can be substituted with suitable adjustments in electrode potentials and drive.

Because nearly every junk box will contain different tubes, I make no attempt to describe my transmitter in detail. Layout is simple and construction un-critical, within the limits of good practice.

Instead, I will try to give you in general terms some ideas you can apply to improvising your own rig from what you already have on hand.

The initial model used a 6AG7 crystal oscillator quadrupling in the plate from a 7 mc crystal. However this didn't supply enough drive, so I built a 5763 oscillator on a sub-assembly mounted under the chassis. The 6AG7 was converted to a doubler. For some reason a 6CL6 would *not* work properly as a crystal oscillator with this circuit. I checked several 6CL6s and none of them would oscillate.

A GDO is helpful in hitting 20 meters with the oscillator plate coil and 10 meters with the driver plate and final tank coils. Three-quarter-inch diameter B&W Miniductor was used for all the coils. The buffer and oscillator are tuned with small 50 mmfd APC capacitors. A receiving type 75 mmfd variable tunes the

final, and a small two-section BC variable serves as Pi loading capacitor.

The screen dropping resistor should be adjusted in value to give a screen voltage on the final which is approximately *half* the recommended screen voltage for regular class C operation.

Voice peaks will then swing screen voltage up to full recommended value.

A number of audio tubes were plugged into the circuits. With this carbon microphone, a 6SL7 (high mu triodes) gave more and better audio than a 6SN7 (medium mu triodes). A 6L6 gave better modulation than a 6V6, 6F6 or similar tubes. The rig would probably benefit from more audio gain.

This could be achieved either by using an additional voltage amplifier stage, or an audio step-up transformer for the mike (or both). If a crystal, dynamic or ceramic mike is used, an extra audio stage will be necessary anyhow.

Several features of screen-modulated amplifiers become pertinent in this rig. Since so much of the design is left up to the improvisations of the builder, it might be well to review a few of the important ones, and look over the angles and pitfalls.

Beam power tubes have several important characteristics which are unique.[3]

(1) The plate current (hence the output) depends more on the *screen* voltage than on the plate voltage.

(2) Screen current rises sharply as grid drive is increased.

(3) Screen current falls off as amplifier loading is increased.

(4) Screen current is *maximum* when the plate tank circuit is tuned to resonance.

Obviously, screen modulation itself is dependent on the first characteristic. In this amplifier, we leave the plate voltage practically steady while we change the screen voltage (and hence, the plate current.)

These audio-rate changes in output produce the "automatic QSB" characteristic of screen-

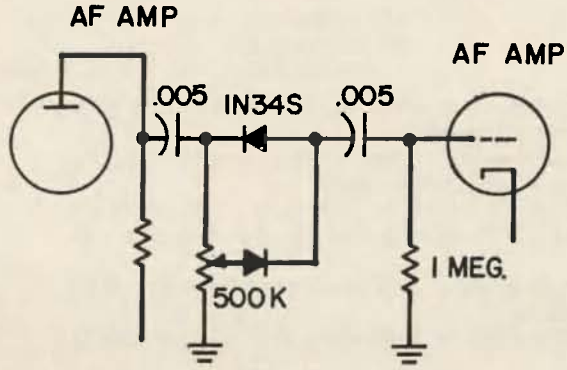
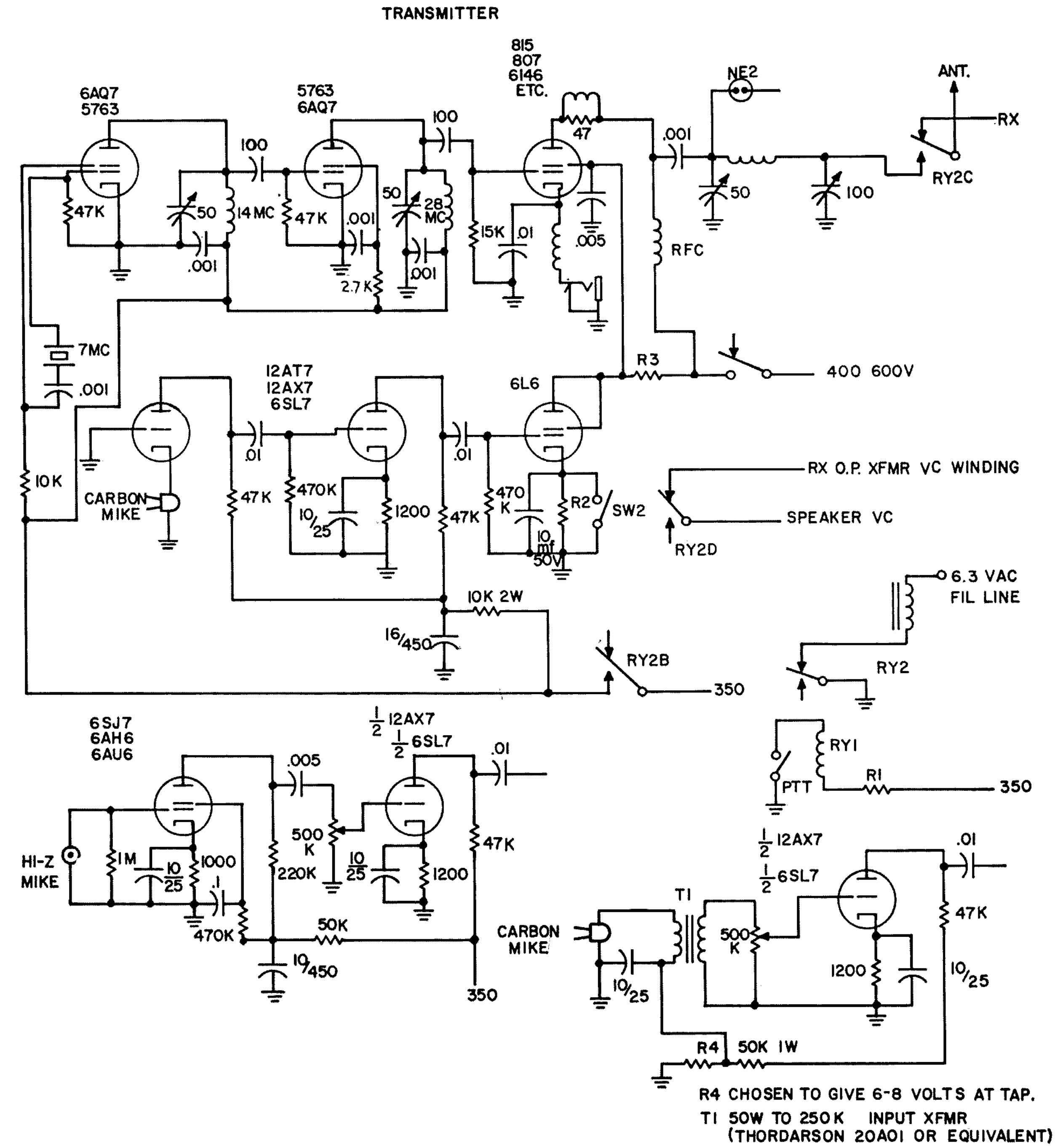


Fig. 2

modulated rigs.

Since *some* plate current flows, even when the screen voltage is zero, it is never possible to screen modulate an amplifier 100 per cent. If some means is provided for driving the screen *negative* on downward modulation peaks, complete plate current cut-off is achieved—but the resulting distortion is horrendous, since this portion of the screen-voltage-plate current curve is *very* non-linear.



R-1—value chosen as maximum which will permit Ry-1 to close positively when the PTT switch is activated. Value will depend on characteristics of Ry-1.
R-3—With an 815 final, R-3 is selected to give about 150 volts on the screens with the 6L6 pulled out of the socket. Value depends on plate voltage used.
R-2—Plug the 6L6 in again and select a value of R2 which will give 50 to 60 volts on the screen with no modulation. SW-1 is open for all these adjustments. R2 probably will be about 1000 ohms, 1 watt.
SW-1—is normally closed for operation. Closed, resting cathode current in the 815 should be about 30 ma, with peaks to 60 on modulation.
The NE-2 may be mounted on the panel to give positive indication that the carrier is on. It will flicker brightly with modulation.
Inset shows alternative microphone input circuits.

It might very well be possible to increase the percentage of *upward* modulation well above 100 per cent by using some such non-linear audio device as the one shown in Fig. 2. I have not tried this circuit myself, but it should be quite effective in increasing the apparent "loudness" of your signal's audio.[1]

The diodes and pot result in supplying audio to your modulator with much higher positive-going peaks, and much lower negative-going peaks than are present in your normal speech. (Polarity of the diodes will depend on how many phase reversals follow the point where it is inserted in the circuit. Wrong polarity will, of course, result in stronger *downward* peaks, which is just what you don't want.)

With the quadrupling crystal oscillator, grid drive to the 815 could not be made to exceed about 1 ma, which is less than half what it should be. This resulted in low screen current (see 2, above) which produced high screen voltage and therefor poor modulation linearity and low percentages of modulation along with poor final amplifier efficiency.

Adding a driver stage brought grid drive up to 2.4 ma which is where it should be on an 815. This brought the screen voltage and current into line, with much improved audio performance.

Choice of a clamp tube is important. Unless the tube can draw heavy plate current (this is another way of saying it must have low plate impedance) it does not exercise the desired effect on the screen voltage of the final amplifier.

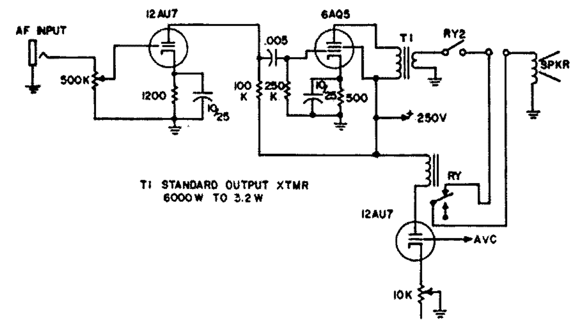
With no audio signal at the clamp tube grid, the plate-cathode resistance is very low, and in effect forms the low end of a voltage divider formed by the screen dropping resistor in series with the modulator tube plate resistance. The final amplifier screen/cathode impedance parallels the modulator tube but is a much higher value.

As the modulator tube grid is driven negative by voice peaks, its plate resistance increases, thus in effect, "raising" the "tap" to which the screen is connected and supplying more screen voltage.

The lower this no-signal resistance can be made, and the higher the mu of the modulator tube, the more effective it will be. Thus a 6L6 works better because it has a lower plate resistance when triode connected and the mu is probably about the same as that of the 6V6, 6F6 and 6AQ5.

Adding modulator tubes in parallel will decrease the plate resistance (both in the no-signal and maximum signal condition) but will not change the mu. (Mu is the ratio of plate

SQUELCH / AUDIO



current change produced by a given change in the grid voltage.)

Adjustment of the transmitter is routine.

It consists of making sure (with a GDO) that all resonant circuits are on the right bands, debugging any parasitics which may turn up, adjusting electrode potentials of all the tubes to their correct values and adjusting grid current in the final to its correct value.

The final step is proper loading of the final. An improperly loaded rf amplifier modulates very poorly.

Over-loading severely reduces screen current. Under-loading results in low output and loss of power.

PTT

The press-to-talk set-up may look a little odd at first. But it is actually quite straightforward. A surplus dc relay with a coil resistance of about 300 ohms was available. It wouldn't operate on the cathode current of any of the tubes, so the dropping resistor was a natural.

The antenna change-over relay is a 4-pdt job not designed for rf work, but it performs ok. Besides changing the antenna, it also turns on plate voltage on the final and exciter stages, and opens the voice coil to the receiver. This relay is mounted in the final amplifier compartment.

Receiver

Since this was to be essentially a fixed-frequency station, there was little need for fancy tuning devices, calibration or the other tricky gimmicks which make many hams unwilling to tackle a receiver.

It uses a crystal converter working into a surplus command set.

Even the converter oscillator crystal came from the junk box. It is a discarded citizen's band unit which gives a difference frequency of 2565 kc, with our local net frequency, and I used the command set which tunes from 1500 to 3000 kc.

The converter is conventional throughout. The 6AS6 is a low-voltage pentode I salvaged from a radar unit (does anybody know what else it's good for?) but a 6C4 or triode connected 6AU6, a 9002 or nearly any other oscillator will work. In fact, any circuit which will oscillate on the proper frequency will work.

With this tube and this crystal, I couldn't get oscillation with the crystal connected between grid and ground—perhaps because the plate voltage used (90 to 100v) was too low. If you use a new crystal it might be advisable to use the circuit recommended by the manufacturer.

The oscillator frequency doesn't matter, so long as you have a receiver to tune the difference frequency.

An interesting feature of this circuit is that the only tuned circuits are the antenna and mixer grid tanks tuned to the operating frequency. The output of the mixer is tuned by the antenna coil of the if receiver. To change output frequencies, it is only necessary to change the crystal.

The antenna and mixer grid coils are rough tuned with a GDO after the unit is assembled, then carefully peaked after the whole receiver is put into operation.

I made a standard conversion of the ARC-5 receiver except that I removed the 12A6 audio power amplifier to save power drain, and converted the BFO to an audio voltage amplifier.

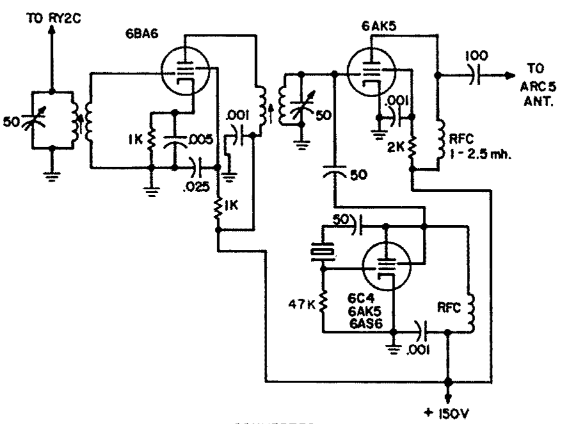
Negative bias to operate the squelch is picked off the diode detector load resistor.

Audio and Squelch

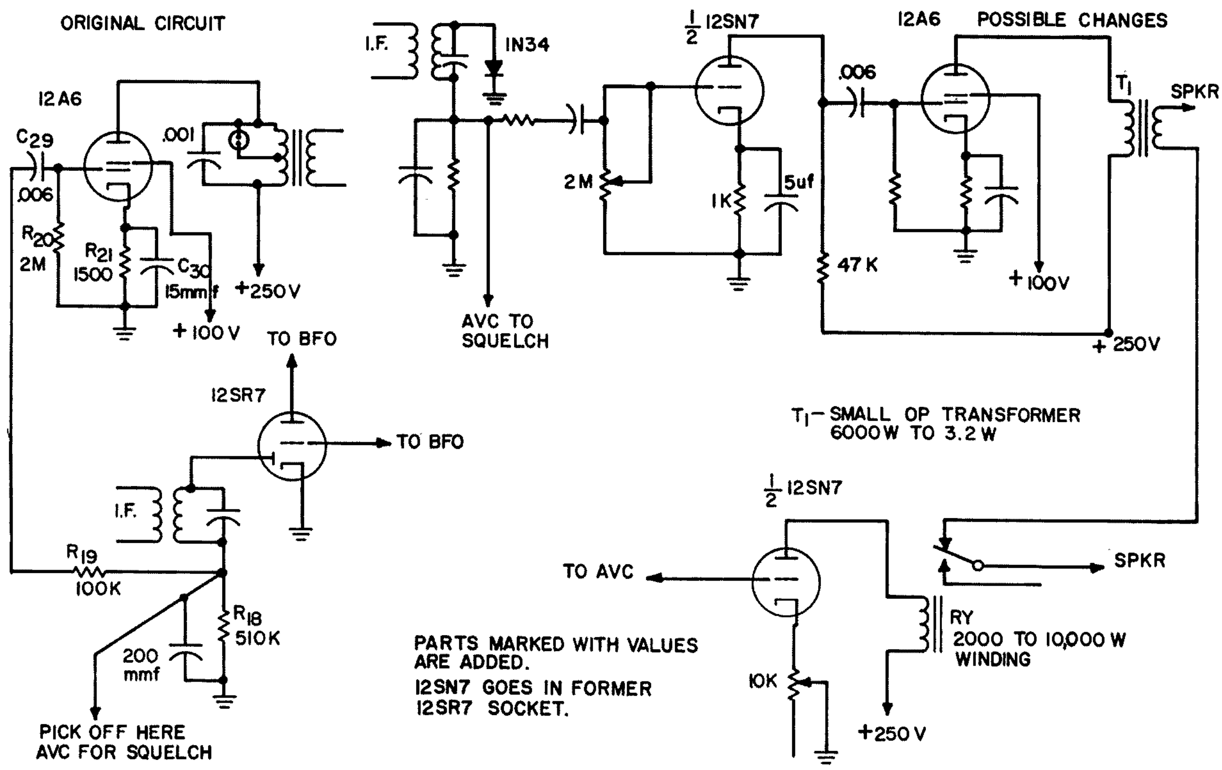
I made a separate unit of the audio amplifier and squelch circuit, so as to permit it to be placed at the operating desk, with the rest of the unit tucked away out of sight.

The audio circuit is a conventional 6AQ5 power amplifier driven by half of a 12AU7 which receives its audio input from the ARC-5.

The other half of the 12AU7 is a relay con-



CONVERTER



COMMAND SET CHANGES

trol tube. When the cathode pot is properly adjusted the relay is just pulled in, opening the voice coil lead to the speaker (or shorting the audio input, depending on how you want to work it).

When a carrier comes through the receiver, a negative voltage develops at the detector. This is applied to the grid of the squelch tube, causing the plate current to drop, permitting the relay to drop out, completing the audio circuit and Presto! we have audio output.

Many other suitable squelch circuits exist.[2] I happened to have components for this one.

There is no reason why this unit could not be built on the chassis of the ARC-5 if desired. There's room on the dynamotor deck. The 12A6 could be retained as audio power tube.

A crystal diode can be substituted for the detector diode in the 12Q7 (or whatever tube is used) and the 12Q7 socket re-wired for a 6SN7. Half the 6SN7 would drive the 12A6. The other half would operate the relay, which can be mounted on the dynamotor deck.

Naturally, any inexpensive receiver can be used as the *if*, including a broadcast receiver.

I debated using a super-regen receiver instead of the more elaborate system I used. I decided on the latter because it is capable of better weak-signal reception, it is not as susceptible to QRM from signals 15 to 20 kc from the net frequency (as super-regens are) and does not radiate spurious signals from the detector. Another factor is the limited choice of squelch for super-regen detectors.

A disadvantage to the system selected is that the *if* is quite sharp, and a net signal must be very close to frequency to be heard.

It would be quite possible to improve on this receiver. For example, a low-noise front end and converter would help with the weak extended-ground-wave signals. Choice of the 7 mc command set would provide a much broader *if*, less critical of small frequency discrepancies of net stations.

Conclusions

I have *not* worked 400 countries with this rig. I do *not* consistently get 5x9+ reports from Bhutan when the band is closed, or while using a wet noodle for an antenna.

However, using a simple fish-pole ground plane antenna about 45 feet in the air, I have one of the stronger signals on a local net dominated by Tenners (4.5 watts) Cheyennes (90 w to poor antennas) and 50-watt mobile rigs.

This rig has worked KZ5, KP4, W6, W7, W3, W2, W1 (on "short skip"—not extended groundwave). It has worked extended groundwave for 50 to 90 miles with a good antenna and comparable power at the other end.

Quality reports on the audio have all been good. Modulation percentage seems to be about as good as you can get with screen modulation. For purists, of course, it would be quite feasible to plate modulate the rig by making a

couple of simple changes in the final screen circuit (like pulling out the clamp tube).

However, for its intended purpose—reliable local communication with no QRM, QSB or QRN—it can not easily be improved on.

Improved receiver performance and a better antenna would extend the limit of reliable groundwave coverage—but even so, if the "better antenna" turned out to be a beam, it would severely limit omni-directional local operation.

For 10-meter buffs who want variable frequency operation, it should be very simple to drive the crystal oscillator stage with a 7 mc VFO. A proper choice of converter crystal and tuning range for the output of the converter will provide excellent 10-meter reception in all parts of the band. For this kind of service, where re-tuning the transmitter is necessary after long QSYs, it would be desirable to put a meter permanently in the cathode of the final amplifier and perhaps a second meter in the grid return, to monitor the drive. Of course, the same meter could be switched back and forth between them, leaving suitable shunts installed in the leads to be monitored.

However, the rig described admirably meets the demands it was designed to satisfy. So I expect it to see a good deal more service before making any further modifications.

. . . W4MLE

(1) CQ, June 1959, page 39, "A Positive Peak Expander," Compton W3BSA.
(2) 73, Dec. 1960, "The Perfect Squelch" staff.
(3) "Understanding Tetrode Screen Current," QST, July 1961, page 26, Meacham—W6EMD.

Letter

Instant Conversion of BC-603 FM to AM

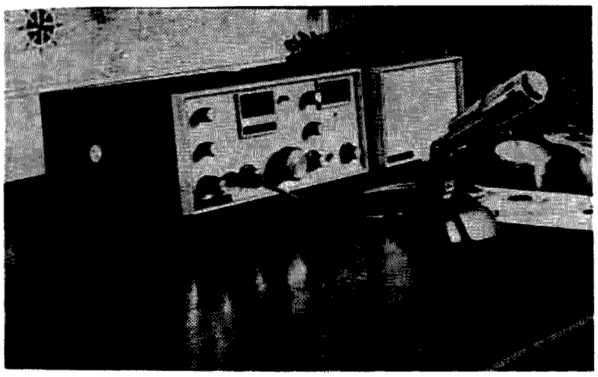
Wayne,

It takes longer to write about this conversion than it does to do it. I acquired a new BC-603 off a disgruntled ham for next to nothing, and spent nothing to convert it, RESULT, one very good Receiver for 20 to 28 mc. On the back is a socket where power and test plug is applied.
JUMPER A WIRE FROM PIN 3 TO PIN 18.
LIFT EITHER END OF RESISTOR R-10.
APPLY POWER. Call lite, BFO, and Squelch all operate as usual.

. . . K9HTM

EXPIRING?

73 subscribers can easily check their date of expiration. The last two numbers indicate this: 53 means May 1963 is the last issue we will send on their subscription. N5 tells you that November 1965 is the last issue.



The NCX-3

Wayne Green W2NSD/1

The bands have been well occupied during recent months with speculation on the many new sidebands transceivers, and the new National NCX-3 tri-band job weighing in at $369 seems to have created a particular stir. The Collins transceivers put enough fellows on the air with mobile SSB rigs to show us all that this was the way to live. The appearance of the Swan single band transceiver proved that a demand had been built up for lower priced transceivers, if you can call completely sold out production any kind of proof. National obviously forecast the trend some time ago and made every effort to come up with a package that would fill the bill.

Many of us have been wondering when National would return to making transmitters, an art form that they have left alone for over twenty years now. How many old timers remember the NTX-30 push-button exciter or the National 600 transmitter? I've got the power supplies and modulator from the old 600 and they are still in daily use driving my two and six meter kilowatts. I expect they will still be going as long as I can get on the air.

Being close to Boston there was little problem in cadging an early production model NCX-3 so we could find out how much of the design of this gadget came from the engineering department and how much from the advertising agency, where it would appear in the ads but not in the finished product, a design technique not unknown in the ham field. Exhaustive tests did not uncover any overstatement of the specifications in the National ads. Indeed, they were invariably on the modest side.

First impressions are important and I must admit to being quite favorably impressed by the trim good looks of the rig, its light weight, and its solidness. The solid extruded aluminum front panel with white anodized (very difficult to scratch) finish give not only the beauty of simplicity, but help considerably to make the unit extremely sturdy for stability.

The installation took about one minute, and consisted of plugging in the power cord, the speaker/power cable to the rig from the separate supply (model NCXA), the antenna and the mike. The back lit tuning dial and S-meter not only look great in the shack, but are particularly good for mobile operation where you want to have a minimum of glare and a maximum of see.

Peaking the Exciter-Tune and PA-Tune controls on the received signal and then loading the final to 300 ma was all that was necessary to tune up the NCX-3. Switching to SSB, I called in on a QSO and was pleased to get good signal reports from all hands. The VOX circuit and anti-trip circuit worked extremely smoothly, doing a lot better job that the earlier engineering model that I had checked a couple months ago. The redesigned VOX circuit and extra stage of anti-trip amplification allowed me to turn up the gain full blast and still have the VOX work when I spoke normally in the mike.

The bandspreaded Exciter-Tune and PA-Tune controls make the tuning quite uncritical and greatly simplify mobile operation where you don't want to fuss too much while zipping along. The main tuning control is a large knob driving the tuning condenser through a 45:1 miniature Velvet Vernier with

no trace of backlash or lost motion. Feels good.

The NCX-3 pulled in everything my NC-303 could. All drift disappeared after less than ten minutes of warm-up. The AGC on SSB was particularly good, with no thumps, even with the rf gain wide open. Selectivity, on both transmit and receive, is achieved by means of a 5.2 mc half-lattice crystal filter which is 2.5 kc wide at the 6 db point. The selectivity is just right for SSB.

The NCX-3 covers the 20-40-80 meter phone and CW bands, making it much more flexible than the single band transceivers. These are the bands that will be most usable for amateurs during the next few years while we are suffering from a lack of sun spots. They are the best bands for mobile sideband use due to the high level of present sideband activity in these bands.

Though the NCX-3 runs 200 watts PEP input to the 6GJ5's in the final using the NCXA power supply, I suspect many amateurs will, as usual, want to see what happens when they run up the voltage with their own supply and PEP it to nearly 400 watts. The tubes run black at 200 watts DC input, so I'll bet there is a lot more soup available there.

The transmit-receive process is all done by one relay, which cuts down on the probability of defunctation. This relay is quite quiet, being electrically silent on VOX (no noise audible whatever other than the mechanical "click") and a just barely noticeable "pop" on push-to-talk.

The VFO is completely shielded and is mounted on a solid ⅛" aluminum plate for stability. The PA is also shielded, a feature which not only helps keep down any trend towards TVI, but also keeps fingers from passing along electrocution to their owner. I feel that all rigs should have adequate protection built in to keep careless operators from suiciding themselves.

The ac supply (NCXA) is hernia heavy with its huge power transformer and two filter chokes. This one stays cool and has excellent regulation. I didn't try the dc supply as the rig was just on loan and I didn't want to make holes in the Porsche. It switches at 200 cycles (half the usual frequency) and gets away from the transistorized whine problem.

Though the NCX-3 is designed primarily for SSB operation, it does put out well when switched to AM. This changes the receiver over to an AM detector and you insert carrier in case you run across anyone that still can't figure out how to tune in SSB. Unlikely. On CW the VOX circuit gives very fast break-in and less than half of the first dit is clipped even with the bug bugging away at 25 wpm. The VOX Delay control lets you adjust the time for receiver recovery from between words to between letters. No sidetone is provided so you have to use a separate CW monitor or know what you are doing without one. Simple matter.

The NCX-3 did a fine job here during our tests, was easy to operate and brought in very complimentary comments. It looks nice, works well, and is certainly reasonably priced. National has done a beautiful job on their return to the transmitter field after all these years.

I guess that the biggest problem that we had with the NCX-3 during our test was that just about every ham that dropped by to see the 73 headquarters ended up mostly seeing the NCX-3, giving it a few flings on the air and then getting mad when we tried to explain that this one had to be returned to National after the test and couldn't be sold to them.

. . . W2NSD/1

Solving the Bird Problem

Robert Swearengin W5HJV
73 Staff

The radio amateur has made great strides in communications . . . RTTY, SSB, VHF, Moonbounce and project OSCAR are indeed a tribute to the fraternity. A glance through any amateur publication will reveal technical articles which command the respect of the most hardened professional. Even the average ham, who might be an English teacher or a lawyer by profession, has a working knowledge of electronics and is able to maintain his own equipment.

In spite of this, however, one phase of the art seems to be standing still. Little improvement has occurred in the CW segment of the hambands, and poor keying is as common as it was ten years ago, if not more so.

The arguments for and against CW will not be discussed here, as this is not the purpose of the article. I happen to enjoy CW personally, but amateurs compose a versatile, loose knit group and we all have our "druthers." Let it suffice to say that CW is efficient and CHEAP, and is therefore probably here to stay.

Considering recent advances in transmitter construction and design, it is difficult to understand the trend toward sloppy keying. The

time was when Joe Ham would immediately zero in on one of those chirpy, buzzy signals, because Joe knew it was probably XY3PU, who didn't have a radio store around the corner, and was of necessity running a pair of surplus 5Y3's in the final. Nowadays, though, Joe tunes in only to discover (after sweating out fifteen minutes of CQ's) that the signal is being produced by good old Lewis Lid over in the adjoining county.

Now, granted it is tougher to tame a signal on the higher frequencies, but what about 80, 40, and 20? The ratio of bad signals to good, even on the lower frequencies, is certainly worthy of consideration. In fact, some evenings the low end of 20 sounds like the aviary at the Dallas Zoo.

This is no doubt partially due to the RSB* system prescribed to by many CW operators. A five kc chirp with raw ac on the final plates might bring a T8 report if the fellow on the other end doesn't happen to like your fist. This type of reporting is misleading to say the least, and is especially tough on the DX station, who often has no other means of checking out his equipment. In actuality, most hams are grateful for an honest report, and are concerned if their signals are not up to par. Perhaps some of the offenders on the CW bands don't realize that their signals are not as clean as they should be.

Oddly enough, the chirps, clicks, and backwaves do not always emanate from homebrew equipment. In fact, as often as not, a commercial job is responsible for the offensive signal. However, this can easily be rectified by a little ingenuity, a letter to the company manufacturing the equipment, or both.

Most keying problems can be solved with a minimum of effort. Certainly grid block and differential keying are to be preferred, but even oscillator keying can be perfectly acceptable with good voltage regulation. If break in operation is not desired, keying the final cathode is simple, and works quite well on smaller rigs.

So how about it, fellows? You too can have a good, clean signal which is a pleasure to copy. The ham has always had a reputation for doing a FB job with the materials on hand, and for solving his own problems. Here is an area of our hobby which needs a bit of improvement. Take an extra five minutes to check your keying with someone across town, and if necessary sacrifice that one evening's operating time to make a few improvements. Then make your next RST report an honest one . . . the ham on the other end will appreciate it.

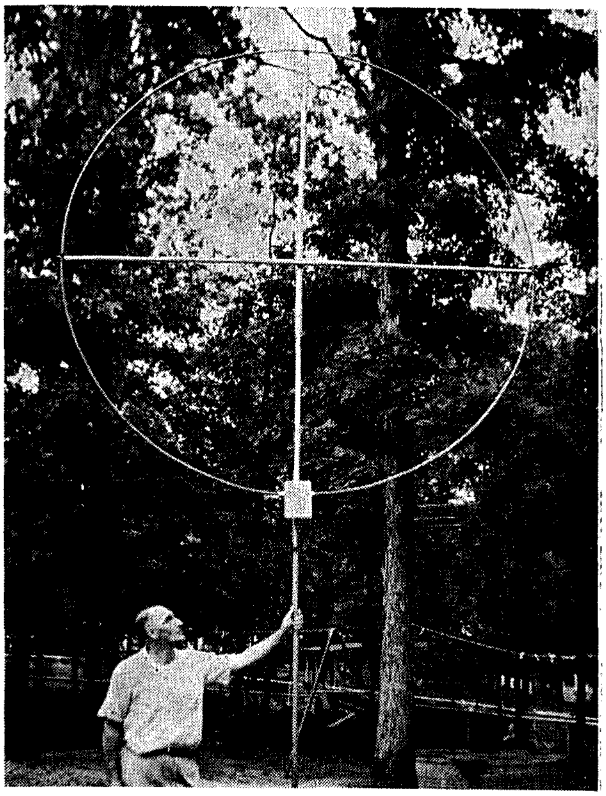
. . . W5HJV

*Readability, Strength, and Bull

How Low can you Go?

Richard Genaille K4ZGM
719 Quarterstaff Road
Winston-Salem, North Carolina

In these days of transistors and nuvistors, lasers and masers, gigacycles and nanoseconds, anyone who starts talking about radio stations operating around 15 kilocycles or below is usually looked upon as some kind of a nut. The author is no exception and, in the process of informing his engineering confreres as to what fascinating things are happening on the very-low and extra-low frequencies, is often subjected to considerable eyebrow raising. This is not surprising at all when one considers that the higher frequencies have been in the limelight for some time. Articles dealing with the radio spectrum below the broadcast band have been few and far between and, unless one subscribes to a wide variety of technical publications, it is almost impossible to realize that significant developments are presently taking place on these frequencies.



The author with VLF loop antenna (18 kc).

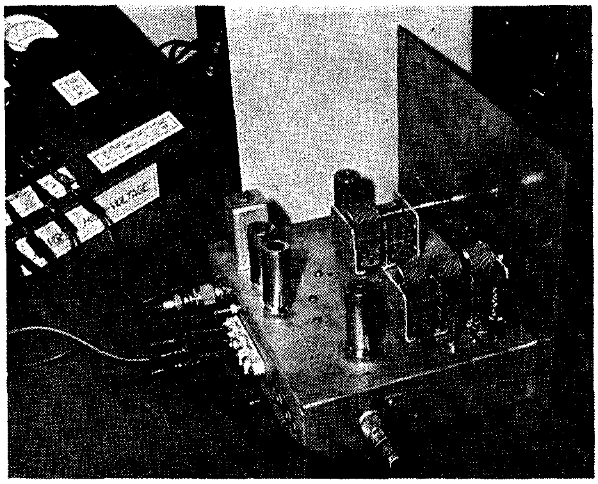
It is beyond the scope of this article to cover in detail all of the interesting and fascinating developments which have been and are taking place on those frequencies below the broadcast band. The author's purpose in presenting this article is to outline briefly some of the "goings on" and to provide a bibliography of recent articles that the reader can consult for further information on various phases of very-low and extra-low frequency work. It might even be possible to stir the imagination of a sufficient number of experimenters so as to produce a run of interesting construction articles on extra-low frequency experiments or on low cost, precise frequency standards for ham or shop use taking advantage of the highly stabilized transmissions of the network of high-powered VLF stations.

To get an idea as to the range of the radio spectrum with which we will deal you may wish to consult Table 1 for the frequency band nomenclature. This table is, of course, a partial listing. For those who are not in the ranks of the very-old timers the long wavelengths from about 3,000 to 23,000 meters were used exclusively in the early days of radio for transoceanic communication and are still used for specific services. Some of the early experiments of Marconi indicated that as the height and capacity of an antenna were

increased, the distance over which communication could be held also increased. For this reason the wavelengths used for long-distance communication gradually increased until World War I when wavelengths of 10,000 meters (30 kc) or more were used with various types of large top-loaded antennas. During and after the war, the wavelengths used continued to increase to upwards of 23,000 meters (13 kc). Experiments made on the higher frequencies after World War I gradually proved the usefulness of the higher frequency bands for worldwide radio communication. Much of the work and many of the experiments that caused the shift to the higher frequencies came from the radio amateur. It may come as a great surprise to a number of hams to know that as far back as 1923, a single-sideband transatlantic radiotelephone circuit was in operation on 55 kc. This transmitter was operated by the American Telephone and Telegraph Company.

To determine how low one can really go let's start out with the low end of the broadcast band and see how far we can go. The frequency allocations for various services are shown in Table 2. From the low end of the broadcast band to about 415 kc we have stations operating in the maritime mobile and mobile service. The well known distress and calling frequency of 500 kc is located in this range. From 415 kc down to 200 kc we have the myriad marine radio beacons, aeronautical radio beacons and aeronautical range stations. In this range you might hear your local airport's station providing weather information or landing instructions to nearby aircraft. As is usually the case one can tune from 415 kc on down to 200 kc and find that the entire spectrum is loaded with stations. Just below 200 kc one can hear stations TUK and MSF transmitting a signal consisting of dots and dashes which, when used in conjunction with U. S. Navy Hydrographic Office Charts, can assist in determining one's bearing with respect to the stations. These stations are known as CONSOLAN or navigational aid stations. From about 194 kc down to 14.7 kc there is a multitude of stations all chattering away with CW. The listing in Table 3 is a small one of the stations usually heard by the author but it is by no means a complete listing. The author was fortunate in being able to obtain a reproduction of part of one of the international frequency lists prepared by the International Telecommunications Union and was amazed to see that there are some 500 or so stations listed for the frequency range from 100 kilocycles down to 14.29 kilocycles.

Receivers capable of tuning the low and



Simple 10 to 520 kc converter constructed by the author.

very-low frequency ranges are available on the surplus market if you do not wish to construct a converter to use with your regular receiver. Some of the popular surplus "buys" which are still available are the BC-453 tuning from 190 to 550 kc, the RAK Navy Low Frequency TRF Communications Receiver covering from 15 to 600 kc, and the BC-348 receiver which can tune the 200 to 500 kc range. The author uses a home constructed converter in conjunction with a Hallicrafters SX-96. This converter, which tunes from about 10 to 520 kc, was described in the September 1961 issue of Electronics World. More sophisticated receivers are available but are quite expensive and are used for making extremely accurate frequency and time measurements using signals from the high-powered VLF stations to be described later in the article.

Much of the more interesting work taking place in the radio spectrum is being accomplished in the very-low frequency range from 3 to 30 kilocycles and in the extra-low frequency range below 3 kc. There are several reasons for this. First, it is known that only frequencies around 20 kilocycles have the usable capability of penetrating salt water. With our Navy's fleet of Polaris submarines roaming the seas of the world there must be some dependable means of communcations provided. The Navy VLF stations are used to transmit messages to these submarines even while the subs are submerged to a depth of 90 or 100 feet. In addition to this feature, the very-low frequencies are not subject to complete deterioration as are the higher frequencies during auroral or other disturbances. In many cases of severe geomagnetic storms and other of nature's tantrums the very-low frequencies are our only means of communication with Europe and other areas of the world. The very-low frequencies have recently come into their own for the purpose of making precise time and frequency measurements. Since VLF signals are usually of the ground wave type the height of the ionosphere does not become a factor as it does for the higher frequencies. The feasibility of transmitting VLF signals on very low radiated power was established several years ago by the National Bureau of Standards station WWVL operating on 20 kilocycles from Sunset, Colorado. Radiating 15 watts, this station was heard as far away as 9,000 miles. NBS has another station operating from Boulder, Colorado on 60 kc. This station, WWVB, presently runs only 1.5 watts and can only be received using special receivers. Present plans call for an increase in transmitter power for both of these stations in the near future.

The U. S. Navy operates a number of high-powered VLF stations which are all precisely controlled in frequency. One of these stations is NBA located in the Canal Zone and operating on 18 kilocycles. NBA operates 24 hours a day and is the station most used for frequency and time measurements. To make use of the transmissions from NBA and WWVL a number of manufacturers have entered the field of VLF tracking receivers. Among these are the Textran Corporation of Austin, Texas which makes a fully transistorized VLF tracking receiver featuring phase-locked reception of VLF signals for long-term and short-term accuracy for frequency measurement. An accuracy of one part in 10^9 can be obtained in intervals as short as 30 minutes. If you want one part in 10^{10} accuracy you can get it over a 24 hour interval. To obtain this type of accuracy using the higher frequencies entails a measurement interval of many days due to the method by which higher frequency waves are propagated. Motorola Incorporated of Chicago, Illinois manufactures a frequency standard with output signals which are stable to plus or minus 2 parts in 1 billion per day. This unit provides 1 mc, 100 kc, and 10 kc output signals. The VLF secondary standard is phase-locked to either WWVL or NBA. Considerable work continues to be done to improve means for obtaining precise time and frequency measurements. The need for this extremely high accuracy is dictated by the future use of satellites for making more precise geodetic measurements. The accuracy with which these and other satellites may be tracked is of prime importance. Work is now being done to utilize the 100 kilocycle LORAN-C stations transmissions as a means of providing precise time

for large areas of the world. For those who may feel the urge to come up with a low cost professional type frequency standard making use of the transmissions of the VLF stations the author would recommend some of the articles listed in the bibliography. Some additional information on making VLF frequency comparisons may be had for the asking from the Hewlett-Packard Company in Palo Alto, California. Application Note 50 describes methods of making measurements using H-P Laboratory equipment. The General Radio Experimenter for June 1962, published by the General Radio Company of West Concord, Massachusetts, discusses in detail VLF standard frequency calibration. For those who wish to know more about Universal Time (UT), Ephemeris Time (ET), and Atomic Time (AT) plus an abundance of other information on Frequency and Time Standards, Hewlett-Packards Application Note 52 is a handy publication to have around.

Not too many years ago it was believed that lower frequency radio waves would be impeded by the ionosphere from passage into outer space. The ionospheric barrier or shield becomes essentially negligible above about 100 megacycles accounting for the wide use of the VHF for telemetering functions in connection with satellite work. On February 21, 1961 a two-satellite combination was launched from Cape Canaveral. One satellite was the Navy's Transit IIIB and the other LOFTI I. The LOFTI I satellite was to have separated from the two-satellite package for the purpose of making certain low frequency tests. Unfortunately, proper separation did not take place which prevented the programmed sequence of events from taking place. Only certain tests were possible under the circumstances. LOFTI I is one of a series of Navy satellite experiments to determine the extent of very-low frequency penetration of the ionosphere hence the name LOFTI for LOw Frequency Trans Ionospheric. The orbiting of LOFTI I proved that VLF radio energy transmitted from the earth was present in the ionosphere in useful amounts. LOFTI I received the 18 kilocycle transmissions from several stations during its orbits. Signals were received as far away as 10,000 miles from their source. The findings of this test have given additional impetus to the investigation of possible use of VLF for communications between the earth and outer space.

A round-up of VLF information would not be complete without a few details concerning one of the Navy's newest VLF stations NAA in Cutler, Maine. The former NAA was origi-

nally located in Arlington, Virginia and was quite well known to the old timers many of which copied their first CW from this station. Some years ago the station in Arlington went off the air. It is quite appropriate that this famous call be used at another station which is somewhat on the spectacular side. NAA is now back on the air with a rather loud voice, 2 million watts, and on 14.7 kilocycles. This station has a tremendous range and is capable of transmitting to submerged submarines in almost all parts of the globe. The size of this monster is hard to believe. The antenna is made up of 64 miles of one inch bronze antenna wire. This wire is supported by some 26 towers ranging in height from 800 to 980 feet, nearly as high as the Empire State Building in New York City. The antenna insulators are over 70 feet long. To maintain and correct antenna tension and strain from wind and ice loading the counterweight towers carry counter balances of 202 tons each. The ground radial system, which is partially under sea water, consists of over 11 million feet of copper wire. As if the facts concerning the antenna system itself were the ultimate, some facts regarding the transmitter are no less startling. Four separate final amplifiers running 500 kilowatts each provide total final amplifier power of 2 million watts. The helix house which houses antenna coupling and de-icing equipment is 8 stories tall and contains a helix coil 20 feet in diameter and 40 feet tall wound with 3½ inch diameter Litz wire. The coaxial matching section is so large in diameter that a full grown man can stand comfortably inside the section. Curious enough, keying of these high-powered brutes on the very-low frequencies is limited to as low as 25 words-per-minute due to the normal Q of a VLF antenna system. The author has heard that all "Harry" breaks loose if these transmitters are used to transmit information requiring greater bandwidth than that which is provided by the antenna system.

Several additional VLF stations have been proposed for installation in the very near future. The Navy plans to install another high-powered station to be located in Australia. NATO is planning to build a high-powered VLF station on the coast of Northumberland in England. This station, which will operate on 19 kc, is to be used for high reliability radiotelegraph transmissions to ensure that transmissions will be immune as possible to the effects of ionospheric disturbances. The power to be delivered to the antenna will be in the neighborhood of 500 kilowatts.

The 3 to 30 kilocycle region was formerly known as the frontier of the electromagnetic spectrum until just recently when lower frequencies were successfully transmitted over a considerable distance in connection with a long-range Extra-Low Frequency study being made for the U. S. Air Force. A 400 cycle-per-second signal was transmitted from Boron, California to El Paso, Texas, a distance of approximately 750 miles. This was accomplished by the use of a 300 kilowatt output 400 cycle alternator for a transmitter and an antenna 2 miles long. These tests were conducted to prove out a theory that long-range ionospheric propagation could be achieved at extremely low frequencies. As far as the author can determine, this is the lowest frequency transmitted over such a range by man-made equipment. Someone at this point is sure to wonder why, with 300 kilowatts of 400 cycle signal originating in Southern California there are not a flock of people running around with ruptured eardrums. It's awful easy to get sucked in on this business of why can't you hear these signals when they are in the audio range. The answer is pretty obvious. It depends on the medium of propagation. If the 300 kilowatts of 400 cycles were coupled to a loudspeaker capable of handling that amount of power there would be a lot of people with severe ear trouble near Boron, California. Fortunately this power was coupled to the atmosphere through the use of an antenna. Enough said.

Below 400 cycles one can only surmise what may eventually take place. It has been suggested that a high-power station operating on a frequency of about 10 cycles may overcome the lightning noise over the entire earth to provide worldwide communication which will be independent of diurnal cycles, sunspots, auroral conditions and other disturbances which can completely wipe out higher frequency communications at times. Some interesting natural phenomenons occur in the frequency range of from 300 to 15,000 cycles which are being investigated by scientists. These are the "whistlers" and sferics caused by lightning and other disturbances which generate considerable electromagnetic energy. The bibliography contains several articles covering these interesting signals generated by Mother Nature.

How low can you go? We had better quit while we are ahead. Experiments are now underway in several countries where they are trying to do something with the resonant cavity formed by the earth's surface and the ionosphere. Observations have been made of this cavity resonance and it has been determined that the fundamental frequency is about 7.8 cycles-per-second with a Q of about 4. The

author sincerely hopes that no one succeeds in setting up a 7.8 cycles-per-second oscillation in this cavity of ours or we will all wind up with scrambled brains.—How low can you go?

. . . K4ZGM

Table 1. Frequency Band Nomenclature

Frequency Range	Frequency Subdivision	Wavelength (Meters)
Below 3 Kilocycles	Extra-Low Frequencies	Above 100,000
3-30 Kilocycles	Very-Low Frequencies	100,000-10,000
30-300 Kilocycles	Low Frequencies	10,000-1,000
300-3000 Kilocycles	Medium Frequencies	1,000-100

Table 2. Frequency Allocations For Various Service

Kilocycles	Service
10-14	Radio Navigation
14-90	Fixed, Maritime Mobile
90-110	Fixed, Maritime Mobile, Radio Navigation
110-160	Fixed, Maritime Mobile
160-200	Fixed
200-285	Aeronautical Mobile, Aeronautical Navigation
285-325	Maritime Navigation (radio beacons)
325-405	Aeronautical Mobile, Aeronautical Navigation
405-415	Aeronautical Mobile, Aeronautical Navigation (radio direction finding)
415-490	Maritime Mobile
490-510	Mobile (distress and calling)

Table 3. Typical Very-Low and Low Frequency Stations Heard By The Author

Station Call Sign	Location	Frequency	Power
NAA	Cutler, Me., U.S.A.	14.7 kc	2 megawatts
GBR	Rugby, England	16.0 kc	300 KW
FUB	Paris, France	17.0 kc	———
NBA	Summitt, C.Z. Panama	18.0 kc	300 KW
NPG/ NLK	Jim Creek, Wash.	18.6 kc	1 megawatt
NPM	Lualualei, Hawaii	19.8 kc	500 KW
WWVL	Sunset, Colorado	20.0 kc	15 watts
NSS	Annapolis, Maryland	22.3 kc	500 KW
WWVB	Boulder, Colorado	60.0 kc	2 watts
MSF	Rugby, England	60.0 kc	10 KW
GYC	Whitehall, England	78.2 kc	———
NHY	Pt. Lyautey, Morocco	112.0 kc	———
WSL	Amagansett, New York	113.0 kc	———
CFH-L	Halifax, Nova Scotia	115.3 kc	———
NSS-WM	Annapolis, Maryland	121.5 kc	———
CFH-LA	Halifax, Nova Scotia	132.5 kc	———
CKN	———	133.0 kc	———
WCC	Chatham, Massachusetts	147.5 kc	———
MSF	Cape Hatteras?	———	———
TUK	Nantuckett, Massachusetts	194.0 kc	———

(Continued on next page)

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High Efficiency Switching

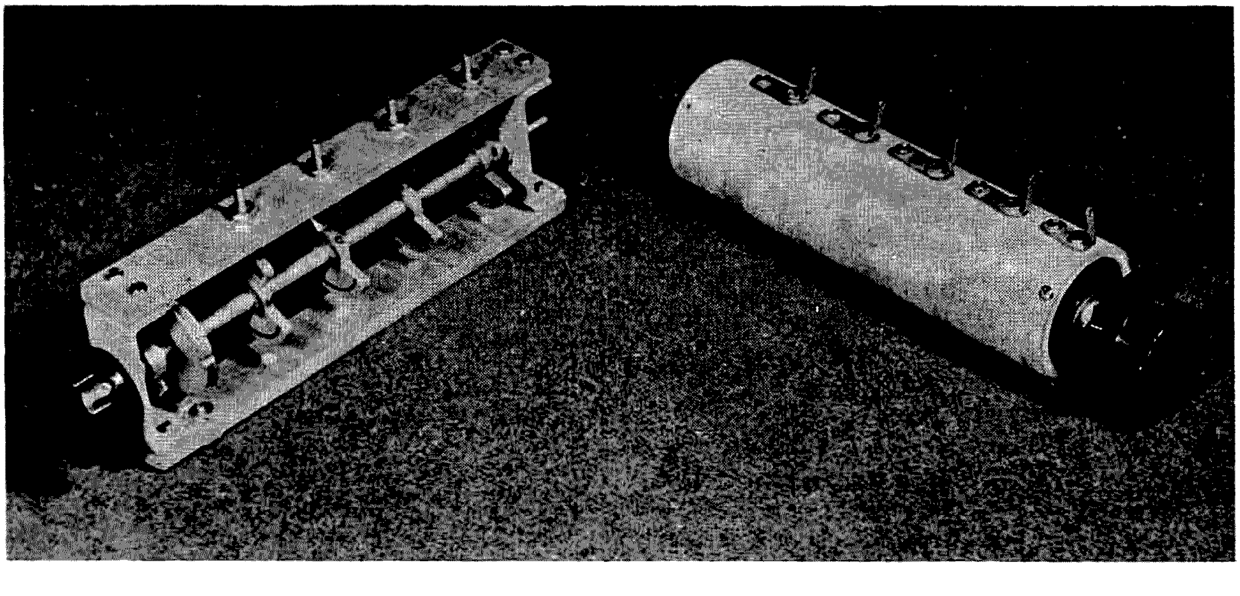
Roy Pafenberg W4WKM

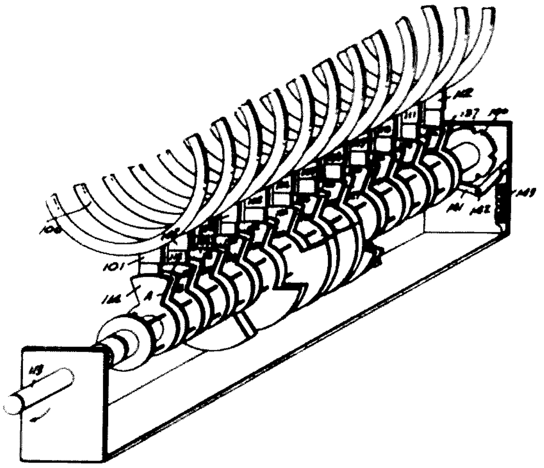
Many methods have been devised for the switching of higher power rf tank circuits but they all have certain disadvantages. The system shown in the photograph is a simple, straightforward answer to many of the problems. The basic device consists of a number of segmented disks secured to a common conductive shaft. The segments are arranged so that, with a coil tap connected to the contact for each disk, the coil is progressively shorted out as the shaft is rotated. The shaft contact is connected to the low impedance or rf ground point of the coil, depending on the circuit used.

The photograph shows two versions of the switch. The open frame model is designed to be mounted parallel and immediately adjacent to the rf coil, with the coil taps directly connected to the disk contacts using short heavy leads. The other model is assembled inside of an insulating tube and is designed to be inserted through the center of a coil.

Advantages of this switching method are obvious. An efficient and direct rf path is established through the low resistance contacts, segmented disks and the conductive shaft. This is in contrast to the circuitous rf path which exists when conventional tap switches are adapted to progressive coil shorting applications. Further, the physical arrangement may be made so that the relatively short coil tap leads do not materially change the resonant frequency of the tuned circuit.

This switching system was devised by Jack Bowden, W4SYJ, to replace the manually installed shorting bars on the inductors used in





the PA and IPA stages of a Press Wireless 15 KW high frequency transmitter. The drawing shows the switch configuration which was used in the push-pull final stage.

The basic system is protected by US Patent 2,493,746 and the "inside the coil" version is the subject of current patent action. Amateurs with access to machine shop facilities are welcome to apply the design as they wish. Manufacturers interested in securing manufacturing rights should contact W4SYJ directly.

. . . W4WKM

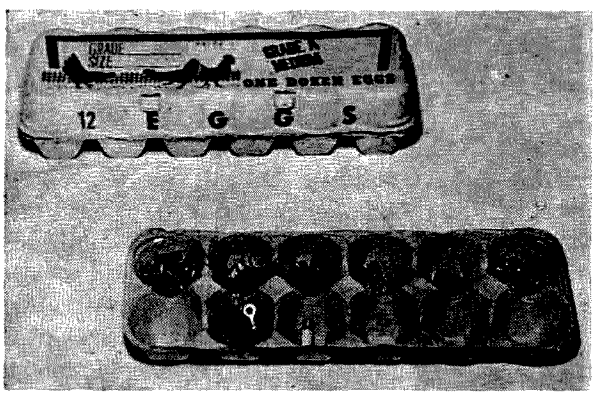
Photo Credit: Morgan S. Gassman, Jr.

Parts Sorting and Storage Trays

Segregation and storage of small parts used in construction projects can be a real problem, particularly with the miniature components now in common use. One "no cost" answer to this problem is shown in the photograph.

The top of an ordinary egg carton may be removed and the tray used for sorting components or hardware. If extended storage is contemplated, the lid may be left on to keep out dust and to permit stacking of the cartons.

Photograph by: Morgan S. Gassman, Jr.



Wayne Green W2NSD/1

The Swan SW-240

Back in May 1961, when I met Herb Johnson at the Phoenix Convention and had my first chance to look over his then brand new Swan transceiver, I was surprised that he was able to turn out such a piece of equipment to sell at the low price of $275. Herb was turning them out from a small plant in Benson, Arizona (where's that?) and hardly able to keep up with the word-of-mouth demand for the product.

The first ad for the Swan was placed by Elliott Electronics in Phoenix in the September 1961 issue of 73. This really put the skids under them to try and keep up with the enlarged demand. Sideband operators began running into Swan users on the air in growing numbers and the enthusiasm of these "salesmen" further bogged things down at Benson. A new and larger plant was badly needed. The new plant was put at Oceanside, California. This gave much better sources of supplies and labor.

When they finally got things running relatively smoothly at the new plant the first ads placed by Swan were run in July 1962. Right from the beginning they were unable to keep up with the demand. The combination of a good product, a low price and a pent up demand for sideband transceivers made things click.

While other manufacturers were aware of the growing demand for transceivers, it must be acknowledged that we wouldn't have over a dozen makes to choose from today if it had not been for the extraordinary success of the Swan.

Herb clearly saw the coming of the multiband transceiver, so new Swan 240 tribander has now replaced the three single band models. It is hard to believe that the price of this tribander is only $45 more than the monobanders. The price of the 240 was kept low by the rather ingenious method of building a sideband transceiver that is designed specifically for that: sideband transceiving. The unit covers all three currently usable SSB bands, has adequate power to be used barefoot, and does not push up the price tab by trying to be all things to all people.

If you do want to use the 240 for AM operation the instruction book explicitly tells you how to make the additions and small changes necessary for this. Isn't this better than putting it in for everyone and adding another $25 or so to the tag? CW ops can easily install grid-block keying according to the instruction book modifications and even extend the range of the 20 and 80 meter bands to cover the CW segments. The 240 normally tunes and transmits lower sideband on 40 and 75, and upper sideband on 20 meters. Since almost all of the SSB operation on these bands observes this custom, the need for switching sidebands is rare. The chap who does want to be able to switch can order a simple kit to add to his 240 which will enable him to get on the wrong sideband and wonder why no one comes back to him.

One of the major problems that has bedeviled ham manufacturers is drift. Commercially built ham sideband gear was virtually impossible just a few years ago due to the warm-up and operating drift inherent in receivers and VFO's. Though these problems have been drastically reduced by modern components, circuits and mechanical designs, we still have not been able to produce a driftless rig. Swan's 240 has an interesting approach to this problem. They do everything possible to keep drift to an absolute minimum and then provide you with a trimmer so you can introduce positive or negative temperature compensation to correct for any variation in components or in aging changes. Perfectionists

should have a lot of fun with this little feature.

The 240 watt PEP of the Swan apparently caused some dismay in the sideband transceiver manufacturing field where everyone watches the other fellows power claims about as carefully as the car manufacturers watch the horsepower claims of competitors. As I understand it, Swan had to get a signed note from RCA saying that 240 watts PEP didn't exceed their ratings for the 6DQ5 before certain magazines would accept their advertising. Heh, heh! I wonder what you can really run to the 240 if you start using ham-type inputs to the rig instead of commercially approved inputs? So the tube blushes a little when you yell, remember what we used to do to 6L6's? On the other hand, 240 watts PEP is about the same effective juice as you put out with an AM kilowatt . . . and for many years this was considered pretty fancy.

There is another factor to be considered here too . . . that little old car battery. Even a heavy duty battery may get kinky if you try to run too much power while mobiling. Alternator systems will soon be popular and perhaps we can at that time give more consideration to the idea of running higher mobile power, with the higher cost of the power supply, etc. For the present the Swan would seem to be a good compromise, running as much power as possible without putting a killing strain on the car system.

Installation

The 240's mounting bracket (included with the transceiver) can be quickly bolted under the dash of almost all cars. The 5½" heighth doesn't force you to wear knee-pads. The loudspeaker of your car radio can be hooked in so a second separate speaker is not needed. The power unit can be bolted to the firewall behind the engine or on one side under the hood, with the power cable feeding through to the rig. The whole installation really shouldn't take more than two or three hours once you get the tools out and get at it. You'll probably spend more time putting in the antenna than the rig.

Well?

We tested the Swan 240 here at the 73 HQ hamshack for several days and were very pleased with it. The reports were more than satisfactory from the chaps we contacted and we could find no advertised specifications that were exaggerated. We all agreed that we really enjoyed using the Swan.

. . . W2NSD/1

Stimulus in the Space Age

Howie Ryder W1WQH

"I wish ideas were born from boredom," I said to Paul W1YPZ as we sat in the Maintenance Shop at Hanscom Air Force Base, Bedford, Massachusetts. I had just returned from England after being stationed there for four years and Paul was back from Labrador. We were off duty today, but we had gone to the Maintenance Shop to read the Bulletin Board. "Let's do something really unique . . . what hasn't been done yet, Paul?" I asked anxiously. "How's about launching a rocket full of Ham gear to the moon?" replied Paul jokingly. "That's it, buddy," I exclaimed, suddenly remembering an incident that I had seen in England. "Let's brew up a 2 meter transmitter and launch it with a balloon. Back in England a couple of "G's" made a little 2 meter transmitter and launched it to 52,000 feet and it was heard 59-plus all over the British Isles. Just think, Paul, we could launch a Slow-Scan Television Camera, or a movie camera, or use Amateur Telemetry just like they do at Canaveral to measure humidity, temperature, barometric pressure, light intensity, or launch a telescope with a camera to see the moon without the distortion of 99% of the atmosphere, or we can take a picture of the sun with the stars out, and . . . and . . . " "Hold on, Howie, we will devote our lives before we even do one of those projects you mentioned," Paul said with apparent enthusiasm in his voice. "Well, Paul, you have been talking of making a computer if you had a use for it; here's your justification." I said coyly.

In no time at all we arrived at the Weather Station of a near-by radio site. After introducing myself and explaining our tentative projects, the Maintenance Chief gave us an old Radiosonde Modulator with the barometric switch and calibration sheet and a 9 foot balloon. He also invited us to launch the balloon from his site as they have a Neems-Clark VHF receiver and can prepare the NOTAM for us. A NOTAM is a notice to all Flight Facilities that an unusual occurence will take place in an airway. This must be filed in advance of any tentative airborne project to the CAA including a complete description of the craft. THIS IS A MUST. Another point worth mentioning is that the object must have an infallible parachute if it is intended to be flown over land.

We arrived back at the shop and I was already planning on launching of a movie camera. I was ready to ask the members of the MARS station to donate for the purchase of an 8mm movie camera at the local pawn shop. Luckily, Paul had been in charge of Photographic Hobby Shop in Labrador and mentioned the possibility of the camera swaying like a pendulum or twisting uncontrollably, and as we had no idea of the light intensity up there we couldn't get the proper settings on the camera, and retrieving it was almost impossible without elaborate tracking equipment. Telemetry could tell us everything except if we could retrieve the payload. The most important consideration on the retrieval is the winds aloft and how they will affect our balloon. The balloon is entirely at the mercy of the winds, and it will travel as fast as the wind. The only man that we knew that could give us this information is the weather forecaster at the airport. When we arrived at the weather station desk the forecaster wasn't there so we looked at the charts on the wall as we waited. The chart that caught our eye gave the winds aloft, their speed and direction, as well as the temperatures. At 30,000 feet the temperature was mi-

nus 45 centigrade and the wind was coming from the northwest at 200 mph. Discouraged at this, we started to leave when the forecaster arrived. We told him of our tentative project and he proceeded to plot a free rising object from the ground to 70,000 feet. The resultant of all winds would make the payload drop about 15 miles west of here. Wow, that shot the spark in us again!!

We listed the information that the balloon payload was to tell us:

1. Altitude above sea level
2. Light Intensity at 50,000 feet
3. Pitch and yaw of payload
4. Possibility of recovery

To do these things we found it was best to take one at a time. The altitude indicator was the easiest to tackle. We had the barometric switch that we had removed from the radiosonde modulator that we were given. This switch is nothing more than an aneroid barometer with the expanding diaphragm pushing a rod that acts as a contact of the switch. As the pressure decreases outside, the air inside the sealed cannister pushes the sides of the cannister. This movement of the sides is amplified by a long rod on a pivot near the cannister, so a minute change of expansion of the cannister results in a noticeable change at the end of the arm. This arm slides along a piece of bakelite that has minute wires, about #24, running across the bakelite. The arm slides across one wire, then it hits the bakelite, and on to another wire, making and breaking the circuit as it travels. We made this switch key an audio oscillator of 230 cps. The output of the oscillator would go to the grid of the crystal transmitter oscillator to frequency modulate it. On the ground we would take the audio from the speaker output jack in the receiver and hook it to a modified VOX circuit. This audio discriminator consisted of nothing more than an audio pre-amp (12AX7) and another amplifier (6C4) with a parallel tuned circuit in its grid to ground set for 230 cps and a 10,000 ohm relay shunted by a 20 mfd capacitor in its plate circuit. When 230 cps was received it would pass thru the amplifier and energize the relay putting on a light. Any other frequency would not energize the relay because the circuit had a very hi-"Q."

The measurement of the light intensity required a little thinking on our behalf. We finally decided to use a multivibrator circuit. The light picked up by the photocell would generate a minute voltage which we fed to a dc Amplifier. The output of this amplifier went to a multivibrator that was voltage sensitive. The

varying voltage varied the frequency of the multivibrator from 10 cps with no light applied to 130 cps with intense light focused on the cell. On the ground we were to utilize the same receiver's audio output and feed it into a bandpass filter to an amplifier. The amplifier had a pre-emphasis circuit using a diode as a resistor. As the frequency was increased, the tubes plate current was increased. We calibrated the meter by laying a photographic light meter next to the cell and taking a reading on the light meter and calibrating our meter. The accuracy was outstanding.

Finally we came to the pitch and yaw problem. This was conquered by utilization of a mercury switch with one common and two poles. If we tilted the switch one way, it would parallel a capacitor with the common capacitor and lower an audio oscillator to about 1 kc. If it tilted the other way a different capacitor would be switched in parallel and it would lower the frequency to 850 cps, and if the payload was rising steady, we would get a tone of 2 kc. The receiving section was the same principle as our altitude detector with different resonant filters in the grids.

Identification was performed by a motor driven coder-keyer from war surplus. Every eight minutes the carrier would be interrupted and ID would come out in CW. DE W1-WQH/1. (ID may be eliminated if the FCC in Washington, D. C. authorizes it in writing; we didn't try.)

The big day came with all the glamour of Lt. Col. John Glenn's trip to space. We bought two tanks of helium for $13.50 and inflated the balloon. Then the pre-flight came. After checking the parachute release (this consisting of a thread hooked to an opened drag chute that would break by wind pressure and allow a big master chute to open up), we checked all the telemetry equipment and it was "GO." We had made a helical antenna as described in the VHF HANDBOOK.

The transmitter was a 6C4 operating crystal-controlled on 147 mc. and had a power input of 250 milliwatts. We fed all the signals from all the oscillators to the grid and FM'ed it. There was absolutely no signs of mixing at all.

Paul released the balloon and it leapt skyward. I watched the panorama of lights pretending that I was the key controller at the Canaveral launching. The light intensity meter went beserk as the cell was aimed toward the ground and then the sky. The Pitch and Yaw lights were beautiful, the ones to the right and left were red and the center was green, and it dashed from red to green to red so fast that I could hardly distinguish them going on and off. The Altitude light blinked on and off rapidly as each time it went on meant the balloon had traveled 750 ft. It was rising at 1300 fpm. We were tape recording the audio in full from the receiver so we could play it into the console again to double check. We also wanted to note any audio drift due to the extreme temperatures it was going to be hitting. The swaying slowed down a bit at 10,000 ft., and went really crazy at 30,000 ft. (I'd hate to be in a balloon at 30,000 ft.). At 40,000 ft. the swaying almost stopped, and as we hit 50,000 ft. the Pitch light was always in the green. A quick call to the weather forecaster told us that the winds at 50,000 ft. were only 3 mph. The light intensity meter read that if we set a camera of F 16 at 1/50 second shutter speed we would get a glorious picture in color. I bet the sight was beautiful. A SWL buddy in Maine heard the signal 59 plus and he was 450 miles away.

All of a sudden everything went haywire. All the lights were flashing like mad. I grabbed the headphones and the transmitter sounded like someone was wringing the oscillator's neck. The balloon had broken at 62,000 ft. and the air was so thin that there wasn't enough pull on the thread to pop the master chute; the drag chute doing the pulling. It was falling mighty fast. We found out later that it was coming down at about 235 mph. Then the lights slowed rapidly and began a descent of 250 fpm. The master chute had opened. We lost communications two minutes later as it got pretty low. I've been thrilled before, but that was definitely the biggest. Everything worked perfectly.

Two days later we received a phone call from a kid in Maynard, Mass. saying he had found the balloon in a field there. We had our telephone number on it. It was pretty well together when we got there, only 12 miles airline from where we launched it. The secret is to have enough lift to get it out of the jet stream as fast as possible, or it'll be leaving you at 200 miles per hour. Total flight time was 1 hr. 45 minutes. Whotta' ride!!

We're almost finished with our camera payload. We are using three balloons because we are aiming at 120,000 ft. We will also be able to release the balloon as soon as the film is gone. I'll be sure to send a photo to Wayne Green and I hope he'll show it to the readers for us. I am also hoping that we, the "hams" of the United States, can contribute as much to the new science of telemetry as we have to the field of communications itself. I urge any club that wants to get out of the rut, and to become scientists instead of technicians, to utilize instead of operate, to make an inexpensive attempt at this new field . . . AMATEUR TELEMETRY.

. . . W1WQH

160 Meter Band Changes

Area	Maximum DC plate input power in watts: 1800 to 1825 kc and 1875 to 1900 kc — Day	Night	1900 to 1925 kc and 1975 to 2000 kc — Day	Night
Ala., La., Miss., Puerto Rico, Virgin Islands, and other U. S. possessions in the Caribbean sea area	No operation		100	25
Alas.	200	50	No operation	
Ark., Ill., Kan., Mo., Okla.	100	25	200	50
Ariz., Col., Ida., Mont., Nev., N. M., Utah, Wy.	200	50	500	200
Calif., Hawaii, Ore., Wash., and Baker, Canton, Enderbury, Guam, Howland, Jarvis, Johnston, Midway and Palmyra Islands	No operation		500	200
Conn., District of Columbia, Del., Mass., Me., Md., N. H., N. J., N. Y., Penn., R. I., Vt., Wake Island	500	200	No operation	
Ind., Ky., O., Tenn.	100	25	100	25
Ia., Minn., Wisc.	500	200	200	50
Neb., N. D., S. D., American Samoa	500	200	500	200
N. C., S. C., W. Va.	100	25	No operation	
Mich.: Northern peninsula	500	200	200	50
Mich.: Southern peninsula	500	200	100	25
Tex.: East of 105 degrees W	100	25	200	50
Tex.: West of 105 degrees W	200	50	500	200
Va.: Arlington and Fairfax counties and city of Alexandria	500	200	No operation	
Va.: All other than above	100	25	No operation	
Fla.: The counties Columbia, Union, Bradford, Putnam, Lake, Osceola, Okeechobee, Martin, Palm Beach, Broward, Dade and counties to the east of these	25	25	No operation	
Fla.: The counties Hamilton, Suwannee, Gilchrist, Alachu, Marion, Sumter, Polk, Highlands, Glodes, Hendry, Collier, Monroe, and counties to the west of these	No operation		25	25
Ga.: The counties Union, Lumpkin, Hall, Jackson, Barrow, Walton, Morgan, Putnam, Baldwin, Wilkinson, Laurens, Wheeler, Telfair Coffee, Atkinson, Clinch, Echols and counties to the east of these	25	25	No operation	
Ga.: The counties Fannin, Gilmer, Dawson, Forsyth, Gwinnett, Rockdale, Newton, Jasper, Jones, Twiggs, Bleckley, Dodge, Wilcox, Ben Hill, Irwin, Berrien, Lanier, Lowndes and counties to the west of these	No operation		25	25

Letter

ELEPHANTS HAVE THE RIGHT OF WAY

Dear Wayne,

I have noted over various issues of 73 Magazine, your interest in Motor Rallies, so am enclosing details of the East African Safari which I hope 73 readers and yourself may find of interest.

Briefly, the Safari is organised by the Royal East African Automobile Association, and is run on a yearly basis usually over the Easter Holiday week-end. The next Safari will therefore be between 11th and 15th April, 1963.

The course is held over East African roads which can vary from a good tarmac surface to rough murram. Road conditions depend a great deal on the weather experienced —it is usual however, to expect rain at some time and place over the 3,000 mile course. The course also varies in altitude from sea level to around 9,000 feet above sea level. These are, however, details with which you personally are probably aware Wayne, and I am therefore writing primarily from a Radio Amateur's interest in the Safari.

Each year the Radio communications around the course are handled by members (and other volunteers) of the Radio Society of East Africa and the Uganda Radio Club.

Because of the nature of the terrain and sparsley inhabited parts of the course, telephone communications are not always available. Radio Mobile stations are therefore set up at strategic control points, where cars are scrutinised and times checked etc. by the Safari Officials. The details are then transmitted back to Nairobi, where the main Safari control point (the start and finish of the Safari) is situated. In this way, it is possible to keep a close check on the positions of the participating cars.

The main safari control point is then able to operate a progress board, which is available for the general public, news broadcasts, etc. In practice our Mobile Stations work on a frequency of around 7070 kc/s with a S/By frequency in the 80 metre band.

Three main stations are usually set up in the three main communication centres and towns of the three Territories of E. Africa—KAMPALA (for Uganda)—DAR-ES-SALAAM (for Tanganyika) and NAIROBI (for Kenya—also the Radio Control Station). These three main stations are usually sited in as far as possible good radio positions, and operate with as much power as possible to the legal limit of 150 watts. The main stations work the mobiles in their own particular countries, then work back to Nairobi control. It should be mentioned here that due to the lentgh of the safari, Kampala (Uganda) will have closed down by the time the cars enter Tanganyika, and Dar-es-Salaam is ready to feed back reports to Nairobi.

The mobiles consist of anything and everything the E. African Amateur can press into service. Equipment ranges from war surplus battery transreceivers to "Maradadi" commercial gear. Where mains supplies are available, they are naturally preferred as sites so that mains supply mobile stations are occasionally located in the local "pub" (which may be on the grid or have its own generator), some small distance from the official check points or controls. Other mobiles "set up shop" at the side of the road with an aerial strung from the nearest suitable tree.

Power inputs therefore, range from a couple of watts up to the legal limit. Ingenuity is paramount—one stalwart who found out there was a mains supply at his official control point, took along a BC.610 in the back of his car (suitably modified for 150 watts—of course!!!). We were faced with a rock-crushing signal from the bush which made the local main station look rather silly!—we still haven't found out how he managed to get a BC.610 in the back of a car.

Another operator faced with a site with no suitable

buildings or trees, finished up with the aerial tied to a bamboo pole lashed to his car—still another had a 30′ whip waving in the breeze. Amazingly enough, these occasional necessary lash-ups do work, and are a credit to the Amateurs participating in an operation which, from a radio point of view, includes some very difficult sites.

In view of the number of control points and radio mobiles required (we operated 32 stations last year), it is usually necessary that some members operate more than one station. Although there are about 60 licensed amateurs in E. Africa, it is obviously not possible for all to be available for the whole Easter Holiday period of 3 days. Thus, some participants open up a mobile, then when all the traffic has been passed, pack up and hurtle across country on a "Safari" of their own to open up another station on another part of the route which will be used later.

This can be expensive if any breakdown of car or gear are experienced by the operators. One member of last year found himself in Mombasa with about 5 shillings (75 cents) to get himself, wife and car back to Nairobi, a distance of over 300 miles. He solved this problem by selling his rig in Mombasa and set out with enough cash for the journey, plus a few beers on the way as well!

To ensure trouble free reception at the network control station (Nairobi) a suitable site—usually a member's house—is chosen a few miles from Nairobi, where ignition or other forms of man made interference are at a minimum. This station operates 24 hours a day for the whole duration of the safari, and is the main source of information for the Safari Officials. Contact with the regional main stations is as stated on 40 metres with an 80 metre standby frequency for the uncertain propogation conditions experienced during the hours of darkness. From the network control station, reports and information are fed to the main safari headquarters control by a phone VHF link. (Incidentally, all the network is normally operated on phone—C.W. being used only under difficult conditions.)

The main safari headquarters control is situated in the middle of Nairobi, where noise on H/F prohibits the setting up of a radio station operating on 40 and 80 metres. (We know—we've tried it before!)

Apart from occasional freak blackouts, we are therefore able to operate a fairly reliable network. Naturally, where telephone facilities are available they are used, but, in the more remote regions the service even if available, operates on a dawn to dusk basis. This means a radio mobile station is required if the cars will be routing through that sector at night.

Other regions have no telephone service at all—there is the added hazard that where lines are overhead, elephants think nothing of using the poles to scratch themselves with usually disastrous results to the service.

With improving DX conditions on the lower H/F bands, it is probable that the next R.S.E.A. networks of April 11/15, 1962 will be heard over greater distances than usual. Reports of reception would therefore be welcomed after the safari.

The Safari Committee are supplying QSL cards to all transmitting members, these should be in circulation in the next few weeks. As a large proportion of them will undoubtedly find their way to the U. S. A. I am enclosing a specimen card, which some of your readers may expect to receive.

Few other Amateur Radio exercises operate under field conditions such as we experience in E. Africa. The local wild life can, and often does, interfere with the safari usually at the expense of the competitor. As local road signs state—"ELEPHANTS HAVE THE RIGHT OF WAY" and "BEWARE OF BIG GAME."

I am enclosing both a specimen QSL card Wayne, and also a copy of the Safari Regulations, which you personally will probably find of interest. If you care to print these details as a small article in 73 Mag, I would be grateful if you could send a copy for the Radio Society of East Africa. I personally do not have a subscription to 73 as with moving around out here, I rarely get a full year delivered. However, you may like to know the magazine is on sale in Nairobi.

Best wishes to you and 73 magazine.

Very sincerely,

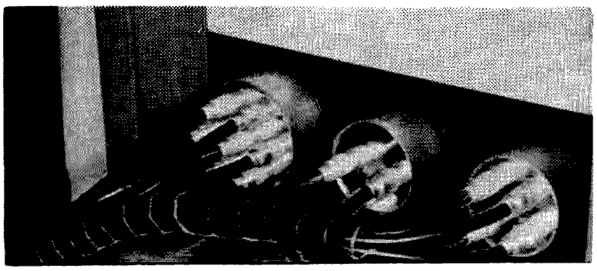
Frank W. Unstead—VQ4GF.
Communications Member,
East African Safari Committee 1962/63.

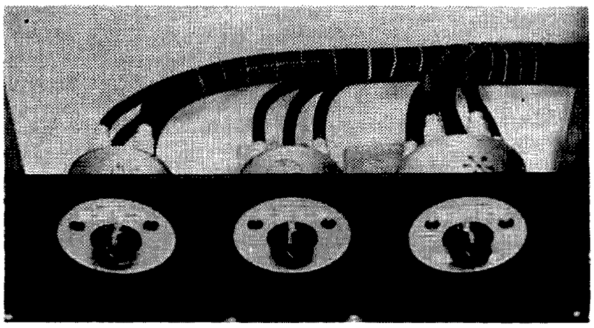
Waters Coaxial Switches

Tom McCann K2CM

The photographs tell most of this story. If you do much changing of coax you've been needing a set of good coax switches. It sure does get old to trace back each of those dangling lengths of coax to be sure it is the right antenna or that it goes to the right piece of gear. Then comes the skinned knuckles as you try to unscrew one cable and connect the new one. Just take a closer look at the way all this can be handled with the Waters coaxial switches.

Waters pulled a clever one on other coax switch manufacturers when he had the connectors come out the back of the switch instead of around the edge. This allows you to tie all those cables together in a neat harness without having to put separate right-angle connectors on every cable.





The photo shows all three types of Waters switches. You need a single contact multi-throw switch for changing antenna feedlines. The Waters Model 335 allows you to connect five different antennas and a dummy load. I do highly recommend that dummy load . . . or haven't you ever had someone plop on top of you and tune up? This does not help make our hobby enjoyable. The antenna switch is on the right.

On the left is the Waters Model 336 transfer switch. This is the one you use when you don't need the linear. Flick and you are on the exciter alone. Why not start a whole new movement in our hobby and do as the law says: use the minimum power necessary for communication. It is a lot more fun to tell the fellows that you are running twenty watts than a kilowatt . . . definitely puts you one up.

The center switch is the Waters Model 341 simple transfer switch (single pole double throw) which I use to switch between the outputs of two different transmitters. This could be used to switch receivers. Before I put in this switch I had quite an investment in coaxial relays to switch over from HF to VHF transmitters.

The results of all this switchification is a much neater shack, a lot less money invested in relays, and much greater flexibility than ever possible before.

Waters has some interesting features on these switches. They are easy to operate, not requiring the usual wrench. The escutcheon plate is grey with white squares for labeling the switch contacts with ink, pencil or decals. The switches are completely encased for shielding and protection against dust and moisture. The schematic of the switch is printed right on the case so you don't have to save paper instructions which have to be found every time you want to make a change. The SO-239 connectors on the switches mate with the usual PL-259 coax plugs. Insertion loss and crosstalk are negligible, right on up past two meters. They'll handle a full kw easily . . . but don't switch while the power is on . . . OK?

Try some of these newfangled coax switches and you'll like 'em. . . . K2CM

New Product

Loaded

Waters Manufacturing is developing quite a ham line. They have just added to their line of coax switches, Q-multipliers for the Collins gear, and Hybrid Coupler (phone patch) by announcing a dummy-load/wattmeter. Boy, would it be nice if more fellows used a dummy load instead of our round-table frequency for tuning up. This unit has three scales reading 10, 100, and 1000 watts. There is a light on the front panel which tells you when the dummy load is ready for a rest. It will work just fine all the way up to 250 mc. $79.75. Available through most of your ham equipment distributors. Send to Waters, Wayland, Mass., for details . . . or just go out and buy one and be done with it.

Strays

It is with deep regret that we report the passing of L. A. Rapp, W1OU, well known for his infrequent and not overly dependable articles. We understand that Mr. Rapp expired in a fit of apoplexy brought on by reading proofs of his latest article for QST. RIP Rapp.

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

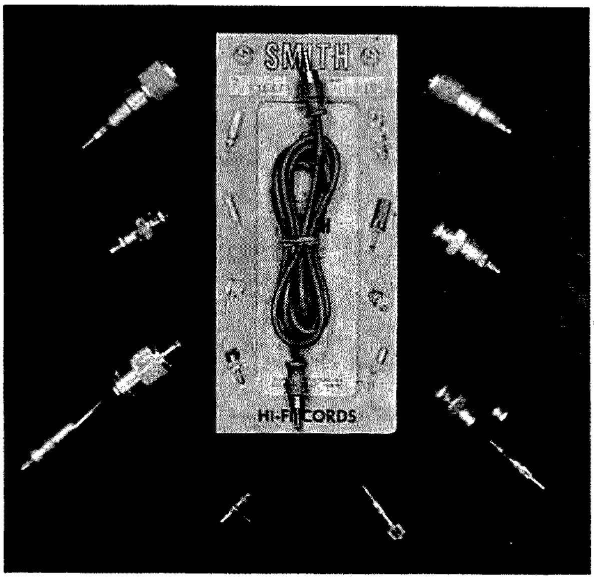
Photo Credit: Morgan S. Gassman, Jr.

Inexpensive Coax Connector – Adaptor System

The Hi-Fi boom has resulted in at least one side advantage to the constructing amateur. The mass market for suitable audio connectors has made available improved phono type plugs and jacks along with molded plug type cords of various lengths. These shielded cords may be purchased with a wide variety of terminating connectors. The H. H. Smith, 4' molded cord shown in the photograph is typical of the various cable assemblies available and which, in themselves, will meet many amateur requirements.

The modern phono connectors shown at the bottom of the photo are the heart of the connector-adaptor system to be described. Both the plug and jack are made of brass, heavily nickel plated. The jack stud is threaded and mounts in a single ¼" hole, using the nut supplied. The plug is equipped with a lug type cord clamp and fitted with a threaded-on brass sleeve. Both of these items are available from numerous sources. High quality Japanese imported versions are particularly economical.

These plugs and jacks and the various coaxial connectors in general use may be assembled into



a versatile series of adaptors that will greatly simplify the interconnection of equipment. While designed for the shop, there are many permanent installation requirements that can be met by their use. A few words of caution are in order. These are, in no sense of the word, high power connectors. Further, neither the connectors or the cords are of matched impedance construction. However, this is no particular problem in many applications. After all, the old reliable PL-259 and SO-239 connectors have been with us for many years and no pretense of matching was made in this series of fittings. As a further precedent, Collins uses the photo type connectors extensively in low power, relatively non-critical applications.

Now, to work. The photo shows several typical examples. In the top-left adaptor, the brass sleeve is removed from the phono plug and the sleeve discarded. The shank of the phono connector is wedged into the ferrule of the PL-259 (Not PL-259A) and spot soldered in place. A bare lead threaded through the assembly and soldered to the tips completes the assembly.

In the top-right adaptor, the ¼" mounting nut for the phono jack is spot soldered in the ferrule of the PL-259A coax plug. A lead is soldered to the phono jack lug, a short length of sleeving slipped over the lead and the jack threaded into the nut. Soldering the tip connection of the PL-259A completes the job. In the bottom-left unit, the same thing is achieved by spot soldering the jack, less nut, into the sleeve of a UG-176/U adaptor.

The center-left adaptor consists of a UG-260/U BNC plug with the phono jack inserted in the reamed-out clamping sleeve. A spot of solder holds it in place. The UG-260/U center pin is soldered to the phono jack lug and the sleeve is then threaded into the body of the coax plug. The adaptor shown at the center-left is similar except the jack mounting nut is soldered to the back of the coax plug clamping

sleeve.

The connector-adaptor shown in the right-lower portion of the photo is particularly appealing. The UG-88/U or UG-260/U clamping sleeve and the shell of the phono plug are both removed and discarded. The coax connector center pin is soldered to the phono plug tip using a short piece of solid wire. The phono plug shank is then threaded into the body of the coax connector. Since the threads match, that's all there is to it.

This series of connector adaptors may be expanded to meet your own individual requirements. These rugged and reliable fittings are easily assembled from readily available, inexpensive materials and the finished product fills a universal requirement.

. . . W4WKM

FOREIGN SUBSCRIPTIONS

The foreign subscription rate to 73 is $4.00 U. S. per year, however we will accept cash or checks in foreign funds at the following rates:

Canada	$3.75	Germany	16 DM
Mexico	$44	Hong Kong	$23
Austria	115 sh	Italy	2500 Lx
Australia	36/	Netherlands	14.50 Fl
Belgium	200 BF	Norway	29 NKr
Denmark	27.60 DKr	Portugal	1150 Es
England	28/6	Spain	200 Ptas
Finland	1.42 FM	Sweden	20.80 SKr
France	20 NF	Switzerland	17.50 SFr

Plot Your Skip Zones

Don Grayson W9QKC
8125 Harrison Drive
Lawrence 26, Ind.

With the decreasing sunspot cycle many of us are going to have to place more dependence on the lower frequencies. With this comes the old low-frequency bugaboo, skip zones, or "Why I can't talk to —." We are all familiar with the fact that the frequencies from around three to thirty megacycles normally propagate by bouncing off of the ionosphere, which acts as a gigantic mirror. Obviously there are going to be areas that the radio waves bounce over or "skip" as shown in Fig. 1.

Now if we carefully plot all of the contacts in a particular band on a map, noting the time of contact, we should get a plot of the areas indicating the skip zones.

There are several interesting observations that can be made from such a map. You will notice that the contact range increases at night and decreases in the daytime. For the first bounce on 40 meters this amounts to about plus or minus 15 miles, for the second bounce plus or minus 50 miles and for the third bounce roughly plus or minus 150 miles.

The contact zones also tend to move out and widen as the sunspot cycle activity decreases. Since the start of my 40 meter chart in 1953 the inner edge of skip zone number three has moved out at least 35 miles.

It is interesting to note that even though my first skip zone just misses St. Louis by about 20 miles I have no record of any contact there.

Predictions can be made as to the expected signal behavior from the station's relationship to the skip zone and time of day. A QSO with a station that is on the outer edge of a contact zone can be expected to increase in signal strength as night approaches. Conversely the strength could be expected to drop if dawn was approaching. It is assumed that isolated QSO's inside the "dead" areas of the skip zones are due to other less dominant methods of propagation. These contacts are usually characterized by great signal strength in that local area, rapid deep fading, and no repeatability.

A sporadic "E" layer cloud is a typical example of this behavior. It can be thought of as a small detached area of ions drifting about under the "roof" of the "F" layer like a cloud. Obviously this cloud will reflect signals into only one rather small area from your station and since this is a rather unstable drifting cloud of ions it is most unlikely that the cloud will retain any permanency.

. . W9QKC

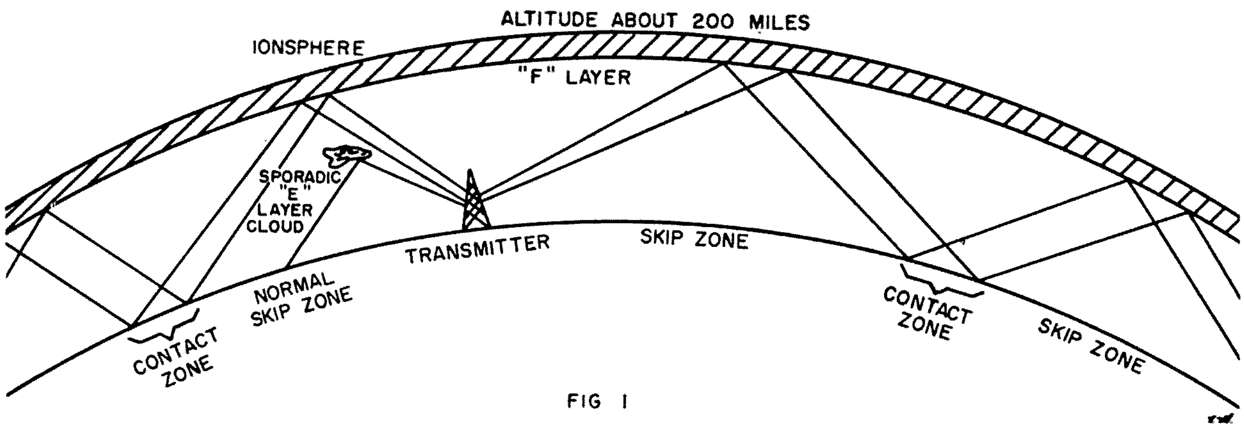


FIG I

The F layer of the ionosphere increases in altitude during the hours of darkness thus moving the "contact zone" further from the transmitter. Note the possibility of a contact in the normal skip zone due to reflection from the sporadic E layer.

Strays

Please be on the lookout for the following which disappeared from the 73 Headquarters Building sometime, we're not sure when, in January or December: 1-VW Station Wagon, 4-RTTY Machines, 1-NC-300, 1 National-600 transmitter, 1-100′ tower, 1-Tribander, and 1-K2PMM, all of which seems to have turned up missing at about the same time. Small reward.

Letters

Cheri—

A visitor from the ACLU added two links to my chain and now I can reach the typewriter.

One harebrained idea a month has been enough, and you've been getting in there first, but you can't keep it up forever. For when you run out of whatever it is you're on, here is a spare—I suppose you are familiar with the "silent period" observed internationally afloat and adrift (15-18 and 45-48 past the hour) and probably think of it as the best time to work DX on 500 kcs. Well, then? Even two minutes at the beginning of each hour (below UHF) (but on all the other bands) would give us lids a chance to hear what the hell is going on beyond the California curtain. From the other side of the Gitchee-Goomee this miniscule Open Door policy might bring cries of delight; it might act like a funnel; it might recall Ellis Island in the eighties; it might be ignored. Forget it.

You will be interested to know that the trouble with 73 is that each issue is not always better than all the preceding issues. Could you use more articles like "Complicating the Simplescope" please. I read it right away because it had "simple" in the title, and I knew it was for us little people. Frivolity aside I think it was the best in the November issue. Of course your editorials are fun to search for potential libel and psychiatric significance, but I really read them for their prescience, wit and logic. You bet. By and large you are doing a fine job with 73 and here on the minimum-security farm it has outrun the other magazines of the "Big Three." We've dropped Vogue and Horizon.

Here's an opening for a professional, deprecatory chuckle and a condenscending pat on my greasy little head. "How's My What?" (Sept.?) brought me mail that surprised me. Another letter came today and gave me the courage to expose my impressionable naivete. As the responsible editor you might want to know that roughly a score of letters and QSL cards have been received, all commendatory and expressing with more or less eloquence a thoughtful, sincere response to the article. Maybe this is an unremarkable reaction—I don't know. As a true blue chap, however, I pass on the facts and let the editor assess them for policy signicance, if any. Noblesse oblige—no snickers.

. . . W7IDF, Ken Cole

Dear Wayne,

As an advertiser in your magazine I want to tell you that I am just not getting results. Last month I only received one reply to my ad. If it weren't that this reply was in the form of a $12,000 order I would cancel my ads.

Name Withheld

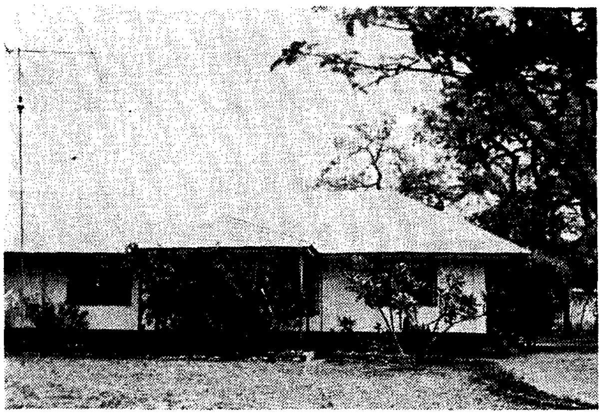
One Ham in a Million!

Carole Hoover K9AMD
401 East Wood Street
Hillsboro, Illinois

Hundreds of U. S. DX-chasers and certificate hunters are indebted to 5N2JKO, Dr. Michael Dransfield, of Samaru, Nigeria, and if you need proof, just check the foreign section of your call book. Obviously, every station in a country with scarcely more than a dozen active hams is vital; but, needless to say, one station who handles not only the QSL Bureau but issues the 5N2 Award is particularly priceless! Such a ham is 5N2JKO.

Mike became a ham thanks to a case of BCI!

"One night in 1947 while I was listening to the BBC at home in England, I heard G2KU working a PY," Mike said. "I didn't know anything about amateur radio, but I copied the PY's address and wrote him a letter. Later, he worked another local, G2AXG, who invited me to his shack."



The QTH of 5N2JKO. His shack is located just to the right of the antenna mast at the left of the photo.

That introduction was enough and Mike became G3JKO shortly after graduating from Nottingham University with a bachelor's degree in Botany, Zoology, and Chemistry.

"After getting my Ph.D. and spending two years in the British Army as a radio instructor, I was off to Sudan where I operated as ST2KO with a 10 watt CW transmitter," Mike recalls. "Next came the transfer to Nigeria in 1959 and a change to ZD2JKO."

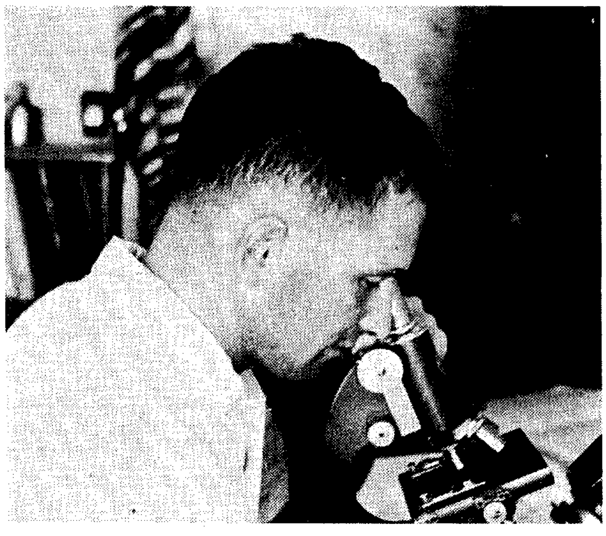
In January 1961, all Nigerian call signs were changed to the new 5N2 prefix following the country's independence from British Colonial rule, and Mike became 5N2JKO.

As a cotton pathologist in charge of controlling cotton diseases for Nigeria, Mike is on the air more between November and April when there are no crops in the ground. He prefers AM and uses a single 6146 at about 40 watts, an Eddystone 888A receiver, and a Mosley TA-33, Jr. beam, keeping W4MCM busy handling his QSL's.

"We started the 5N2 Award in September 1961 to stir up a bit more interest among amateurs here and overseas, too," he stated. "And it was at the request of certificate hunters around the world also. So far 108 awards have gone to about 35 countries."

The award is given to any amateur contacting five Nigerians since January 1, 1961, using phone, CW, or both on at least two bands. QSL's aren't needed, but a check list showing call sign, date, time, band, and reports will do the job if accompanied by five IRC's. Shortwave listeners can get an award by sending five QSL cards and the IRC's to 5N2JKO, Dr. M. Dransfield, Regional Research Station, Samaru, Zaria, Nigeria.

Handling the country's QSL bureau keeps Mike in touch with other active amateurs including 5N2AMS, Angus, and his XYL, 5N2-DMS, who are famous for their DX-peditions.



Dr. Mike Dransfield, 5N2JKO, shown in his laboratory examining some bacteria. He operates more when crops aren't in the ground.

Mike is shown with a few of his many QSL cards. From Nigeria, his personal score is 204 countries worked and 173 confirmed on both fone and CW with 133 confirmed on fone only.

AM operators are 5N2SMW, 5N2BRG, 5N2RJO, and 5N2JSC. Apt to be found on either AM or CW is 5N2RSB, 5N2RDG, 5N2ATU, and 5N2FEL. CW specialists are 5N2IJS, 5N2LKZ, and 5N21ND. Answering on SSB are 5N2EBL, 5N2BCF, and 5N2JAH. VP5JG is operating currently as 5N2JRG.

"Mail takes up to 10 days to reach the more distant parts of the Northern Region, and telephone service is very primitive," Mike said, "so all of the 5N hams work together as a club regardless of vast distances between us. We meet twice a week on 40 meters to keep in touch."

Joseph Beke, one of Mike's assistants, is shown at work. Dr. Dransfield is a cotton pathologist for the government.

Planning an extensive trip across Africa in December of this year, Mike is looking forward to his first Stateside visit in December 1964. By the time he arrives, it's safe to say this enthusiastic ham is apt to find a red carpet of ham friendship stretching from New York to San Francisco.

. . . K9AMD

Operating News

There is no operating news this month.

What is a Ham?

Elmer Olson K7GPZ
5733 North 41 Place
Phoenix 18, Arizona

First and foremost he is a person 10 to 75 years of age who had or has the good sense to pick a good hobby. He is, by and large, a good citizen, above average in intelligence and has a well-rounded knowledge of his hobby. At least this is true of the Hams I know or to whom I have talked. He has respect for the law, having studied government F.C.C. regulations, and values his ticket enough to walk the "straight and narrow." He does not hesitate in letting his fellow Hams know, if in his opinion, they are "skating on thin ice." His purpose in pursuing his hobby is the advancement of Amateur Radio and the comradery enjoyed while talking to fellow Hams.

There is no other hobby I know of which offers such a wide variety of interests and affords the opportunity to practice any or all of them. The potential for good-will all over the world is limitless. Here are a few—

Builders — The builder leans toward the introvert type, but he is the backbone of Ham Radio. He is constantly trying new circuits, improving his transmissions and in the process discovers new, more efficient, more compact and in a great many cases, cheaper ways to build receivers, transmitters, antennas and a large variety of test equipment. In the younger Hams, in this category, you will find the future Electronics Engineers, Technicians, and a good supply of trained men for the Armed Forces. He is the man his fellow Hams call on to help in solving a knotty technical problem. He always seems to have the time, no matter how busy he is with his own affairs, to lend a hand.

Rag Chewers — These are the extroverts who will talk for hours on any and all subjects. They come from all walks of life, trades, and professions. If you listen, particularly on sideband, you can hear most any subject discussed pro and con and by experts. Do not sell the Rag Chewers short. They have disseminated a lot of knowledge down through the years.

Clubbers — These are the organizers, the men who delight in getting people together for Club meetings, Ham Fests, Field Days, etc. They are invaluable in knitting together a group of area or community Hams into a solid organization. Their purpose is to get all the Hams together socially and technically and to encourage all members in the organization to participate in community affairs, civil defense and emergency operation. They are also the public relations men for Amateur Radio.

DXers — This group is always looking for that "rare one" on the other side of the globe. They have the patience to wait it out and in the process learn more about people and geography than most of us "willy-nilly" DX Hams.

Contesters — Nothing delights this group more than running up a big score. To be up near the top they must be constantly improving their stations and perfecting their operating techniques. There is a lot of competition and anyone near the top had to earn it.

Awarders — These boys are out for certifi-

cates, WAS, WAC, WAZ—etc. They are also in the extrovert class and want to show their accomplishments. They are proud of their awards and work hard to get them. We all have some cracks in the walls of our shacks which could be covered by one or more of these framed certificates if we made the effort to qualify.

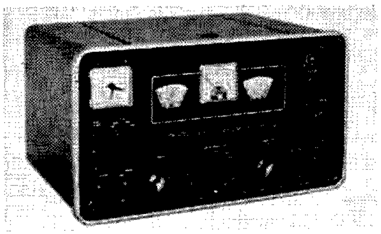
Teachers — Teachers, I guess, are the same the country over, dedicated to impart knowledge even when the pay is not so good. Teachers in Ham Radio are no exception, they spend hours of their free time teaching Radio Theory and Code. Their satisfaction is in taking a group of beginners through the Novice Class and winding up with a group of competent General Class operators. We can all think back to someone who encouraged us and carried us over the rough spots.

The Handicapped — Last, but by no means least, are the physically handicapped. Some are blind or near blind, some are semi-paralyzed and confined to wheel chairs. Some have heart conditions, which preclude anything but the minimum amount of exertion. These Hams keep in touch with the world, gladden the hearts of our Service men and missionaries abroad by running phone patches to relatives in the States. They handle emergency traffic and by and large are always on the job. I might add, at this point, that there is never a shortage of able bodied Hams to help them keep their equipment in shape, from checking tubes to erecting and repairing antennas.

There are also duties and obligations connected with this business of Ham Radio. Loyalty to your local Clubs and National Organizations, who are trying to protect our interests by alerting us to adverse legislation, is one. We are strong enough in numbers to make our presence felt if we will take the time to write our Congressmen or otherwise make our thoughts known. We should pay proper homage and respect to the pioneers who made this absorbing hobby possible. Our operating technique should be such that courtesy and "give and take" should take precedence over being "technically right." There is room for all of us in all modes, classes and frequencies if we will pick our spots and times. The Golden Rule will also work in Ham Radio.

I know I have only touched on a relatively few points on "What is a Ham," but I think it gives the general idea.

Finally, I would like to repeat again, what other Hobby makes possible such a variety of interests, opportunities for private or public service and personal satisfaction? ...K7GPZ



Letters

Dear Wayne:

WA6DEA has pointed out a glaring error in The Instantaneous Dissipateor Tube article of August (page 49). Seems as though I forget about the other half of the cycle in a half wave rectifier system (A voltage doubler is really two half wave systems in series). Assuming the supply is unloaded, the capacitor will charge up to peak voltage of 1000 volts on the positive half cycle. On the negative half cycle the secondary voltage will be in series aiding polarity thus giving a total of 2000 volts inverse peak on the rectifier. So if there is any thought of unloading the supply it would be wise to use 5 silicon rectifiers on each side of the voltage doubler circuit. At W7CSD I have never allowed the supply to be unloaded to the point that 1400 volts is exceeded. This is too high for 1200 vip system used. Guess I have just been lucky. WA6DEA also suggests the installing of a 500K resistor across each of the rectifiers to insure equal voltage division across the series string. Again I have been lucky with my 3 for $1 silicons and have not lost any via this route.

. . . Bob Baird W7CSD

NSD:

I got sick, sick, sick of the meaningless grid printed on the limp plastic of the CRT of my kit 'scope. So I had W0KLG whomp me up a plexiglas disc with two intersecting lines scored on it. Half way out on each arm is a small mark. This disc replaces that irksome grid and since the human eye is excellent at interpolation a high degree of accuracy is still possible. The 'scope looks 100% neater.

Bob, K0GKI

Dear Wayne,

You might mention the far more popular VHF-FM frequencies of 146.94, 147.3 and 147.5 mc along with the Video Rangers on 52.525 mc. This being a channel two area six meters ops frequently get lynched.

. . . Fritz Hervey W9IIU

Dear Staff:

Three days ago a friend let me glance through your October issue. There I saw your article, "A Like-New Mixed Circuit." Since my old Super Pro was starting to feel its age I figured that this might be just the tonic.

So, after stuffing the mag. into my coat pocket when my friend was occupied with that ZL station he needed, I excused myself and hurried home to see if at last this might be my solution to that high noise level, low signal level, etc.

Using a war surplus LP-5 signal generator to set an "S" signal of 2, I found that I just could pick out the signal through the noise. So out came the soldering iron, and the rest of the elements.

The conversion itself took a bit over one hour. Most of the time was spent looking for the 4.7K resistor.

After alignment, the set was tuned on and it was found that a full 3 "S" units was gained. The conversion made was for the 12AT7. However, a 12AU7 produced just under 2 units and a 12AX7 produced just under 3 units.

All in all, the time spent was more than justified in that the noise level that had bugged me so before was now in the background.

Going a bit further, I pulled the first RF and replaced the circuit with a cascode circuit. After alignment, a reading was taken and it was noted that with a 12AT7 in the circuit I would pick up only 2 more "S" units. So, I pulled the second RF tube and replaced it with another cascode circuit. After I was able to kill the oscillations that kept creeping in and re-aligning the front end, I had gained another 2 units. Not only that, but the noise had retreated to the point of "just barely!!!"

Well, I have returned the magazine that I made off with, and have had several comments from visitors as to the FB way my "OLD WARHORSE" sounds. And now I'd like to thank you for printing the article. It sure works good. And best of all, it makes an old RCVR "LIKE-NEW."

. . . Jim Whitfield K6BHN

Strays

WoDSU and KoKEK are the first members of the newly formed Real Rag Chewers Club with a six hour QSO. WA2RIN and WA2UOA became members with a contact a few hours after the WoDSU QSO. WoDSU was also the first winner of the Worked Almost All States Certificate. W1PYM submitted the first cards for the elusive DXDC award. WAoAVG was first to join the exclusive Certificate Haters Club.

New Product

Epsilon

has come up with a corker of an idea in their new code practice record . . . it tells the story of Nicola Tesla. I doubt if you could find a more interesting or incredible story to tell on a record either. Tesla was a fantastic genius, though few people know much more about him today than that he probably had something to do with the Tesla coil, whatever that is.

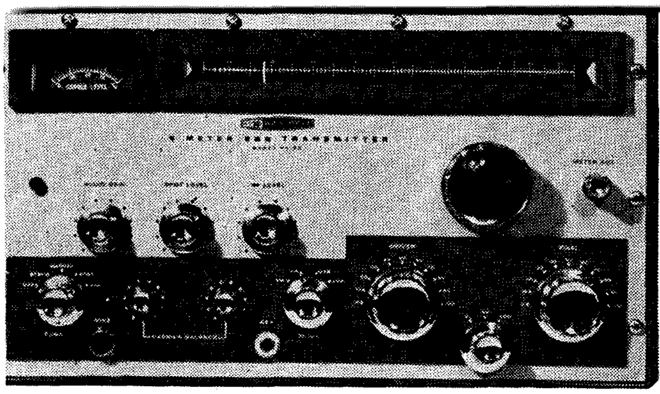
Tesla, this man of which few of you have heard, probably did more to make the world the modern place to live that it is today than any other single man in the history of the world. He has had more impact on our lives than any world leader. Tesla was not just an inventor, he was a discoverer of basic principles. This is April and I'm making it all up, eh? Well, this is fact . . . Tesla lived and he changed the entire world as a result.

What, you ask skeptically, did Tesla invent? He discovered so many basic principles that it beggars the imagination. As a starter he discovered alternating current. He invented the ac generator, the ac motor, the transformer, the high tension transmission line, the electric clock, etc., and had virtually all of the basic patents in the field. He gave us every essential of modern radio, including the tuned circuit, the loudspeaker, remote control and even radar. He discovered neon and other gaseous tube lighting, fluorescent lighting and even some lighting methods beyond those we now have today. He planned and started construction on the first true broadcasting station, several years before engineers even admitted that it would be possible for voice to be broadcast.

It was Tesla who conceived the three phase system as well as single phase system. It was he who established sixty cycles as our power standard. Who thought of putting transformers in oil? Tesla. In 1890 Tesla demonstrated the first diathermy machine. He discovered "X" rays and described them quite accurately 13 years before their official "discovery." He developed the first radio tube in 1890 and described his proposed broadcasting system in 1893. When you consider that Marconi started studying electricity in 1895 this is perhaps in better perspective.

Tesla came up with many more incredible discoveries . . . some day I'll have to write an article all about him. You'll find this Epsilon record not only a great help in learning the code, but of great interest for its content.

. . . W2NSD/1



Heath 6M SSB Transmitter

Kent Mitchell W3WTO

Almost every metropolitan area of the United States has experienced a boom in 6 meter activity during recent years . . . due in no small respect to Heath's introduction of their now famous 5 watt power house, the "Sixer." Then too, and especially during band openings, quite a few of the boys may be heard modulating a Heath 120 watt "Seneca." Indeed, our most popular VHF band might sound altogether different without Heathkits. Now however, 6 meters is going to sound different *with* Heathkits . . . namely the HX-30. This new SSB transmitter is going to become as popular as sliced bread!

A complete, self-contained unit (not a "transverter"), the HX-30 offers a frequency coverage of 50.0 to 54.0 megacycles in four, 1 megacycle steps, an ultrastable fine tuning VFO, and excellent on-the-air audio characteristics with unwanted sideband suppression on the order of 40 db. Carrier suppression is 50 db below maximum rf output.

Providing 10 watts peak envelope power output SSB, 10 watts of CW, and 2.5 watts with AM, the rig may be used as an exciter for a linear amplifier (such as Heath's HA-20, to be featured in a later article), or run "barefoot" with excellent results.

The single sideband signal is generated in this transmitter by the phasing method. Beginning right at the mike input, let's follow the audio through the rig until it emerges from the antenna coax jack as a single sideband rf signal. The heart of the rig is the balanced modulator shown in Fig. 2. A speech amplifier not only boosts the mike input, but attenuates the audio frequencies below 300 cps and above 3000 cps, which experience has shown to be the only really necessary range for good voice intelligibility. The audio is now split into two equal, but 90 degree out of phase signals by an audio phase shift network. Amplified by V3A and V3B, these voltages are applied to the grids of balanced modulators V4 and V5. An rf carrier is generated at 11.5 mc by a crystal controlled oscillator V2B and also applied to the grids of the balanced modulators after it too has been split into two 90 degree out of phase signals. So now, at the grids of V4 and V5 we have two separate carriers being combined with modulation. Here is where we eliminate the carrier and produce the desired single sideband signal. Both balanced modulators, consisting of two triodes each, V4A, V4B and V5A, V5B, each have their grids connected in parallel for rf, and in push-pull for audio through. The plates of each balanced modulator are connected in push-pull through a common tank circuit and are 180 degrees out of phase with each other. The

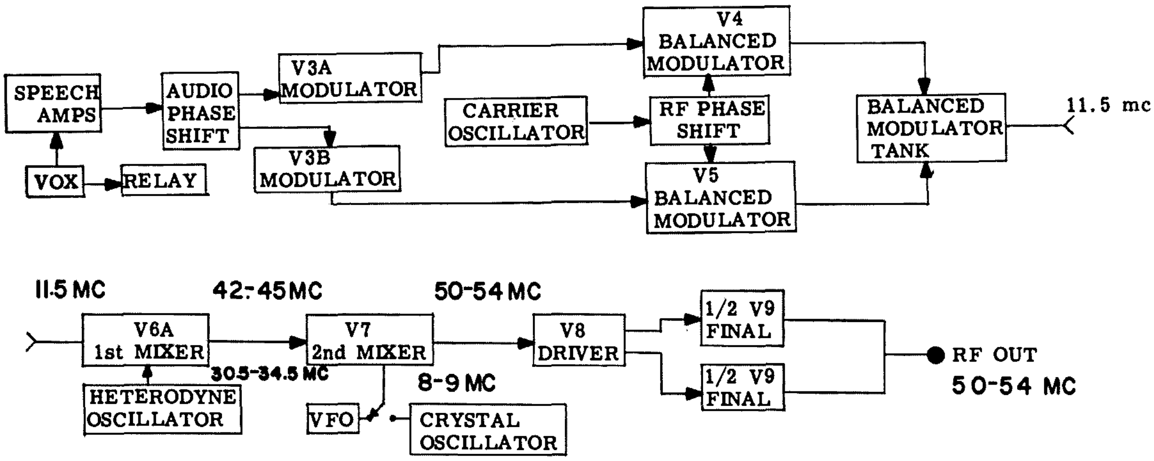


FIGURE 1
HX-30 BLOCK DIAGRAM

product of all these phase relationships results in the carrier being balanced out and four sidebands containing the audio, with two in-phase sidebands combining and two out of phase sidebands canceling . . . leaving only a single sideband signal. A more detailed explanation of how this phasing occurs may be found in several good texts available, such as the *Single Sideband Communications Handbook*. Howard W. Sams and Co., Inc. ($6.95 from Radio Bookshop). Two CARRIER BALANCE controls on the front panel of the HX-30 are pots in the cathode circuits of the balanced modulators and enable their output voltages to be adjusted for equal amplitude.

Transition from upper sideband to lower sideband, and vice versa, is performed simply by reversing the phase of the audio signals on the grids of the balanced modulators. Placing the MODE switch to the AM position removes the audio from the grids of V5, unbalances V4A and V4B, thereby reinserting the carrier in the output at T4 and combining it with two out of phase sidebands . . . or in other words, giving us a conventional AM signal. The CW mode is produced in a likewise manner, with the exception of removal of audio from both the balanced modulators.

So, we now have a SSB rf signal at 11.5 mc, a long way from 6 meters, but from here

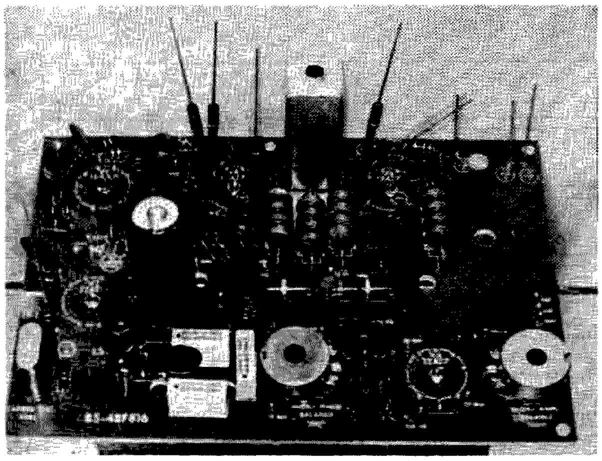


Fig. 2

on out the rest is easy. The 11.5 mc signal is coupled to the pentode section of a 6U8 tube operating as a mixer, where it is heterodyned with the output of a crystal controlled oscillator, the triode section of the 6U8. When the oscillator crystal frequency is 30.5 mc, the output of the mixer is 42 mc. When this 42 mc signal is heterodyned in the second mixer, a 6CB6 (V7), with the output from the VFO or an 8 to 9 mc crystal, we will have a 6 meter

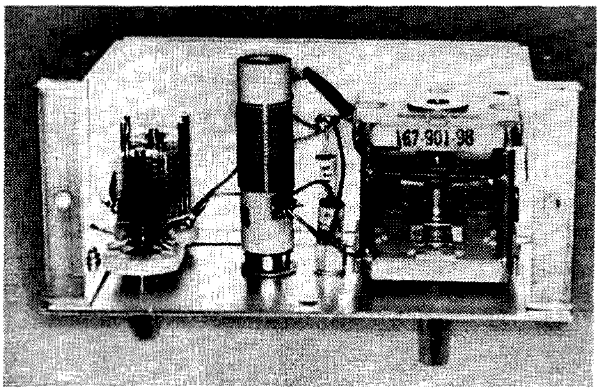


Fig. 3

signal, between 50 and 51 mc. Other 1 mc segments of the band may be covered by changing the first oscillator crystal to the appropriate frequency. A 31.5 crystal will cover 51 to 52 mc, a 32.5 mc crystal will cover 52 to 53 mc, and a 33.5 crystal will provide an output between 53 and 54 mc. Output of the second mixer is coupled to a 6AK6 driver amplifier (V8) and then to the 6360 final amplifier, operating as a push-pull Class AB1 amplifier. Link coupling is employed from the final to the rf output jack.

Assembly of the HX-30 is a pleasant and satisfying task, easily accomplished within the 30 hours mentioned in the Heath ads. Actually, I required 29 hours, in spite of the fact that I was taking notes and photographs as construction progressed, having this article in mind. Rapid assembly is made possible by the use of four heavy duty etched circuit boards and three precut and laced wiring harnesses. Obviously, a great deal of forethought and planning went into this transmitter, both

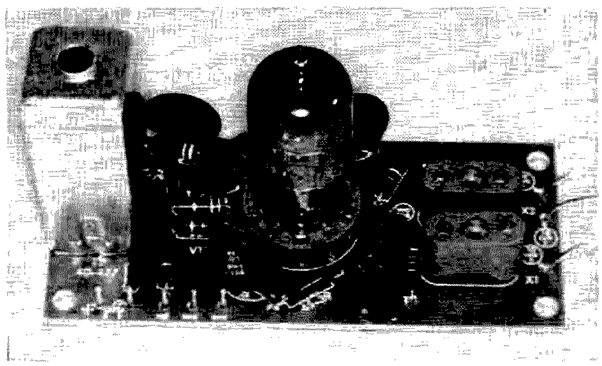


Fig. 4

mechanically and electrically. To cite one example, the tubes and circuit components are located on opposite sides of the etched circuit boards. When the boards are mounted, the tubes protrude upward through the chassis, thereby isolating the components from tube heat. Another example along the same lines is the complete isolation of the VFO tank circuit from other circuits. Fig. 3 shows the interior of the VFO tank compartment, prior to its complete shielding. On the right is the VFO frequency capacitor, to the left are a bandspread trimmer and a temperature compensating capacitor. Fig. 4 is a close-up of the VFO circuit board. Note the two crystal sockets which are for optional crystal control, utilizing the triode section of the 6CH8 VFO as a Colpitts oscillator. Figure 5 shows the completed VFO assembly. The large fine toothed gear visible in the background is a portion of the VFO gear drive assembly. Providing exceptionally smooth VFO tuning, the helical gears give a ratio of approximately 45 kc per turn of the spinner knob. Nine inches on the slide rule type dial equals only one megacycle of the 6 meter band! Compare that to your present 6 meter VFO or receiver dial.

Alignment of the completed kit is simple and requires a minimum of time and effort. An unusual feature is the use of test point jacks and a test probe connected to the front panel meter for alignment. The meter is then normally used as a rf power output indicator and to null out the carrier. The initial adjustment of the audio phase and amplitude controls require an oscilloscope for optimum suppression of the unwanted sideband, but once set need no further attention.

Other features of the HX-30 well worth mentioning include complete shielding of the

final tank assembly, copper plated cabinet interior, built in VOX and anti-trip circuitry, and grid block keying along with a key click filter for clean CW signals. Although the rig was basically designed for SSB operation, it will produce good signals with other modes of transmission . . . no skimping was done here. Also, all Heathkits now include a sufficient supply of multi-core solder at no extra cost. Another pleasant surprise was the inclusion of five free log books and a fine simulated leather vinyl cover.

On the air tests resulted in reports of excellent audio quality, no trace of carrier and very good suppression of the unwanted sideband. Several QSO's were made with stations 75 miles over the Blue Ridge mountains, quite a haul for only 10 watts on 6 meter ground wave, and a feat that is hard to duplicate with a lot more watts of AM from this QTH. Needless to say, sideband really gets through.

Even as I was testing my own HX-30, I heard several other local stations using them on the band. Haven't you ordered your HX-30 yet? See you on 6 meter sideband!

. . . W3WTO

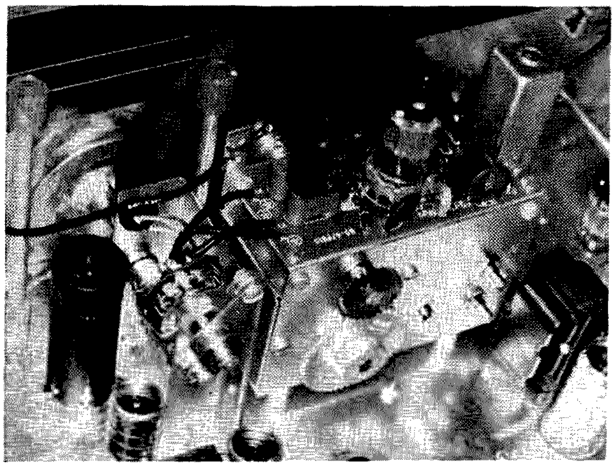


Fig. 5

SPECIFICATIONS

Frequency Coverage—50.0 to 54.0 megacycles in four, 1 megacycle segments. VFO or crystal control.
Emission—SSB, selectable upper or lower sideband. AM (inserted carrier with low level, amplitude modulation).
RF Power Output—SSB (P.E.P.) 10 watts
AM 2.5 watts
CW 10 watts
Carrier Suppression—50db or more below maximum output.
Unwanted Sideband Suppression—40db or more below maximum output at 1000 cps input.
Distortion Products—30db or more below maximum output at 1000 cps input.
Hum and Noise—40db or more below maximum output.
Output Impedance—50 to 75 ohms, unbalanced.
Crystals—11.5 Carrier oscillator (furnished) 30.5 First heterodyne oscillator (furnished), providing operation between 50.0 to 51.0 mc. Crystals for higher band operation are not supplied.
Audio Frequency Response—300 to 3000 cps.
Keying—Grid block keying with key click filter.
VFO Tuning Knob Ratio—Approximately 45 kc per turn.
Power Requirements—117 VAC 60 cps @ 95 watts.
Dimensions—16⅝" wide, 10⅛" high, 10" deep.
Weight—40 pounds.
Price—$189.95

(W2NSD from page 64)

ten weeks for *Life, Changing Times* and *Aquarium*. And the difficulty I had with the *National Observer!* I subscribed to it twice (poor memory) when it started. First I tried to have the two subscriptions made consecutive, then, after I had read the paper for a few days and found it a crashing bore, I tried to cancel my subscriptions. Fat chance. I gave up after about ten letters, none of them nasty, and let them send the silly papers until they got tired. *Newsweek* is a lot better.

Our subscriptions are now being handled on a daily basis right from our headquarters and complaints, which are almost unknown now, are handled immediately. No matter how good we are from now on I know I'll have fellows come up to me at conventions years from now to tell me that they have never subscribed because they heard that we never send subscriptions. I'll kill 'em.

IoAR vs ARRL

Letters to the Institute of Amateur Radio have divided themselves into several discreet groups. There are those from fellows who are interested in our present projects of travel and aid to Ham-TV, wide-band FM, etc. Then we find a group of letters from fellows who are suspicious that the IoAR is out to get the ARRL, which seems to me to be rather silly, at best, in view of the clear statement that was made when I first announced the Institute. Then we have letters from fellows who suggest functions for the Institute over and above those so far outlined. No doubt, as the Institute gathers force, there will be services that it can render and activities that it can foster, but much as the large group of ARRL dissidents dislike the idea, I believe that we should make it a basic tenent not to overlap or duplicate services and functions of the ARRL.

Quite a few letters express the thought that amateur radio is not being adequately represented and that something should be done to improve this situation. They suggest that the Institute should attempt to represent the amateur. Frankly, I am astounded at the ignorance of fellows who make such a suggestion. Surely by now they must know that the Institute cannot represent the amateur. Surely they must have absorbed some faint notion of the present legal setup in our country for the changing of our rules and regulations. Is it possible that anyone can, after all these years, be unaware that it is the individual amateur that has full say on these legislative matters and whose responsibility it is to communicate his interests to the FCC directly? The FCC made it as plain as they possibly could that while they would consider the comments of all clubs and interested groups on any proposed legislation, that the decisions on all matters would be made on the basis of the arguments submitted by all interested parties. This means just what it implies: the FCC wants to hear directly from the amateurs, not from the Institute. The Institute cannot, unless it wants to set up its own laws, represent the amateur.

Since we are all on the air and can talk over ideas that we have with an unlimited number of fellows in this way, we are all in a good position to work out new legislative proposals to submit to the FCC. Our magazines are a fine sounding board for new proposals too, for they make it so everyone can consider the new ideas and discuss them on the air.

It is unfortunate that so few amateurs are apparently interested enough in their hobby to register their opinions with the FCC on proposed rules. With apathy at its present level it is quite possible for a handful of fellows to exert a strong influence on the hobby. Someone has to speak out for our hobby . . . why shouldn't it be you? We lost our "battle" for reciprocal licensing last year just because everyone was hoping that someone else would do something. The best we managed to stir up was a small flutter of letters. Some battle.

Let's suppose that you have thought things over quite a bit and feel that you have some good practical ideas for changing the present amateur regulations. After talking these ideas over on the air and finding that you are not out there all alone with your grand plan, your next step is to put your ideas down on paper and document them with all the facts you can. Send this paper and 14 copies to the FCC, Amateur Division, Washington 25, D. C. The Amateur Division is run by some mighty savvy hams and if you are out in left field somewhere in your petition they will either turn it down or let it die of starvation. If your ideas seem to have promise they will probably feed the petition into the hopper and it will

(Turn to page 118)

Strays

K6BX would like to make schedules with other hams who suffer from Logorrhea. W6RNC please note.

IT ADDS UP

Let's sit down and discuss this matter of subscribing calmly and unemotionally. The fact that we are almost insane on the subject of your subscribing should have no bearing on the matter. What matters to you, primarily, is that by subscribing you pay less for your magazine (only 25c a copy on a three year subscription, a saving of $5.40). You also don't have to fret over possibly missing one of our special issues which seem to disappear from counters and newsstands almost overnight. Heh, heh . . . wait'll you see our special June surplus issue. We are also preparing special sections on towers, quads, VHF, etc., for future issues. Your subscription copy comes to you wrapped in a sturdy wrapper so it won't be dog-eared and beat up.

Name .... **Call** ....

Address ....

City .... **Zone** ...... **State** ....

☐ **$3.50 One Year** ☐ **$6.50 Two Years** ☐ **$9.00 Three Years**

☐ **$40 Life (yours or ours)**

50c each enclosed for the following back issues ....

(Jan. '61 and June '62 out of print) **Class license** ....

☐ **$1.00 enclosed for one year membership in Institute of Amateur Radio.**

73 **Peterborough, N. H.**

(W2NSD from page 116)

get a docket number designation. Once published, you can be sure that every amateur who doesn't like the idea will be grumbling about it and many will file the necessary fifteen copies of rebuttal. Supporters will also have to send the usual 15 copies. You can also be sure that the ARRL will file their comments. While the ARRL comments are not supposed to carry any more weight than individual comments, you can be sure that they will be well thought out and, if for no other reason, on this basis alone carry much weight in the final analysis.

If not too many good reasons have been brought out by interested amateurs and the League against your proposal, it is possible that the FCC may eventually change the regulations and your brainstorm be put into practice. This has happened to a lot of fellows down through the years. I remember quite vividly the violent and long drawn out battle that we had over getting RTTY FSK on the lower frequencies. Everyone seemed to be against us, but we finally made it.

It doesn't seem to me that there is any need for the Institute to enter into this business of representation of the amateur. The ARRL is doing what little representation that is possible these days, so why duplicate? There are more than enough undone things to help our wonderful hobby without attempting to duplicate existing functions of the ARRL.

TV on Two & Six

The Institute has been busy supporting one of the smallest of the splinter ham groups, the Ham-TV'ers, by submitting a petition to the FCC for the allocation of two one megacycle television bands in the upper reaches of the six and two meter bands. Should the FCC take favorable enough action on this petition to assign it a docket number we will publish the full text of the application.

Some of the systems for getting a television signal on the air are so simple now (see our book on Ham-TV by WOKYQ and the bimonthly ATV Bulletins) that the major limiting factor holding back the development of further experimentation is the restriction put upon us to remain on the 420 mc band or above. Since one megacycle wide TV has been proven practical and since the top two megacycles of the six and two meter bands are virtually unused at present and are not needed to provide adequate frequencies for AM, CW, SSB or RTTY communications, their use for amateur television would not only facilitate the

growth of ham-TV by making it possible for the many amateurs who are now active on these bands to try this new mode of operation, but it would also provide an effective answer to those critics of the amateur service who point to our present lack of utilization of these important frequencies.

Please note that the Institute is supporting this petition in behalf of the ham-TV group and not as a representative of the radio amateurs in general, though we did run a questionnaire in 73 which was answered overwhelmingly in favor of this petition and thus tended to indicate that the readership of 73, at least, thought this was a good idea. Until such time as all hams are 73 readers and become eloquent in their own behalf, I don't think it will be possible for the Institute or 73 to even consider representing amateur radio.

I note, with some regret, but no surprise, in the March issue of *QST* that the ARRL intends to oppose the development of ham-TV, as they did RTTY some years back. They fought with every strategem they could muster to prevent FSK RTTY on the low frequencies. They feel that the ARRL slow-scan system should be promoted, but that amateurs should not be encouraged to try restricted bandwidth television since the "techniques to be used would be crude copies of commercial practices . . ." This decision by the ARRL was made by the Executive Committee. I believe that a simple polling of the amateurs who have shown an interest in ham-TV will show them, as it showed me, that the opening of the six and two meter bands to ham-TV is as crucial to the development of this phase of our hobby as was the opening of the low frequencies to ham-RTTY'ers.

QRM

The W3PHL article in February evoked several angry letters. The gist of the complaint was that PHL has been transmitting an unholy signal on 40 and 75 and refuses to stop. Unfortunately none of the angry complainers had anything more technical to contribute than that PHL's signal is too broad. Though I was not aware of all the emotion choked up in Fred's little tempest on the low end of 75, I do feel that I would be doing great harm to the basic principles of freedom which our country champions if I were to reject articles on the basis of the personal popularity or unpopularity of the authors.

Obviously the high power complications of the article will run afoul of either FCC inter-

(Turn page)

(W2NSD from page 119)
pretation of current regulations or future clarifications of the rules. However the low power applications might be important where we want the maximum go per watt.

The publication of the article should prompt our more erudite readers to submit articles clarifying any inaccuracies and we all will have learned something.

Ham Manufacturer

On some lower level of awareness I suppose I realize that it is ridiculous for me to keep thinking about starting a sideline of ham gear. You probably know how I feel for most of us get the urge every now and then to try our hand at making some gadget and selling it to our fellow hobbyists. I have quite an added advantage in this for few people are in as close touch with a market as I am with ham radio through the hundreds of letters (mostly unanswered, I'm afraid) that come in here daily.

There probably is a small shred of jealousy over the success of CQ's venture into manufacturing with their "Raytronics" Nuvista-Plug VHF preamplifiers needling me. I had always been held back from serious consideration of manufacturing by worries and doubts as to the reaction of other manufacturers (these are the advertisers, son) in the field. Apparently, like many other accepted beliefs, this one was a little leaky in the applied logic department. Well, I may learn slowly, but I do learn.

Another goader into this field of endeavor is the failure of many other ham manufacturers to make a go of it. I've watched quite a few sink into oblivion in the last few years, most of them quite unnecessarily.

The insurmountable stumbling block for me is picking the name for this enterprise. Several come to mind, but how can I make a firm decision when I want to use them all? There is Aabco, a fine name for a company because it will always be listed first in any advertising list. Zzyd company will inevitably be last on any list. Then there is the Rosy Prospects Company, a name I spotted over in Formosa a couple years back while on Operation World Wide. Or why not be matter of fact about it and have Stuff Manufacturing Company? How about Debacle Manufacturing Company, then every item we turn out could be stamped "Debacle." Or maybe Caveat Emptor Manufacturing? Or perhaps we should be devious and call it the New Hampshire Pickle Works, like that Horseshoe company that actually makes tools these days. Honey-Bucket Engineering might be to the point. Or perhaps Our Gear Works. Maybe something more modern, like Do, Dad! Manufacturing . . . then every product would have Do, Dad! on it. Or Capitalistic Swine Manufacturing Company. How about the Honest John Division of El Gyppo Company? Possibly Carbunkle Labs? Or even Festerbestertester Labs, which would be fine for answering the phone.

Many more equally apt names come to mind, but apparently I am frozen into immobility by indecision . . . or is it perhaps that I am so utterly behind on keeping 73, the Institute, the European Tour, the 73 Parts Kits, Radio Bookshop, and dozens of other little schemes from collapsing?

JOB

It might be a good idea for us to run a little help wanted list in 73. Every now and then someone calls and wants to know if I can recommend anyone for a particular job. Usually I can't. For instance, just the other day a chap called who has a rather interesting proposition for a ham between 28-45 who has some management and possibly financial experience. This looks like it has good possibilities. If you are interested drop me a letter giving your complete history, credit and personal references, photo, etc. If the chap is interested he will pay your way down to Texas for a personal interview and if you are accepted he will give you a contract with provisions for later participation and salary expansion. He is prepared to pay relocation expenses. Actually he has two businesses that are about to be started and he will be needing two good hams to run them for him. It will be a lot of work, but it should be worth it.

While we've had more than enough applications for summer work here at 73, we're still keeping an eye peeled for one or two hams to join the staff on a permanent basis. The closeness of our work makes personality factors even more important than experience, for an eager fellow can learn the work and we haven't the time to invest in psychotherapy to correct little personality faults such as inconsideration, laziness, dishonesty, sloppiness, and stupidity. The pay is lousy and the work is hard. The days are long and the weekends short. But we're going places . . . or have you noticed that this issue is 128 pages, the largest issue we've ever published? Many of our staff will be going on the European trip this year, new members will probably be able to go on future trips.

What is the work? There are so many things to do it is hard to even start. Manuscripts have to be kept track of and processed. Advertisers

have to be coddled. Equipment has to be tested. Dishes have to be washed, horses have to be fed, cars have to be washed, towers have to be erected, envelopes have to be stuffed, our offset press has to be run and cleaned, books have to be kept, the house has to be cleaned, new buildings have to be built, typewriters have to be cleaned, stencils have to be sorted, wrappers have to be addressed, things have to be filed, walls have to be painted, letters have to be answered, books have to be mailed, kits have to be assembled and mailed, magazines have to be carried, filing cabinets have to be struggled around, booklets have to be assembled, the HQ station has to be kept active, new antennas have to be tested, our parts kits have to be built and tested out, and 1000 other things.

There are reasonable apartments and houses in the vicinity, and we have room in the HQ building for temporary living while house-hunting progresses. Warning: if you are not used to handling responsibility plus night and day work, forget it.

QUESTIONNAIRE

Back in February we ran a little quiz. Perhaps you'll be interested in the results. Manufacturers certainly will be.

1) 40.5% of the readers answering the questionnaire indicated that they may be trying out six meter sideband this year. I was a little worried about all those companies going into the manufacture of sideband gear for six, but obviously I needn't.

2) 29.2% felt it likely that they would be going sideband mobile this year. Manufacturers please note: based upon the present circulation of 73 this would indicate that our readers will be buying over 22,000 sideband mobile rigs. This should keep everyone in business.

3) 12% indicated that they might go on our flight. Since we can only possibly handle two tenths of one percent of our readers on the trip I hope that there is a decided bias in this figure.

4) 75% wanted more emphasis on VHF. OK fellows, write more VHF articles. We'll print 'em.

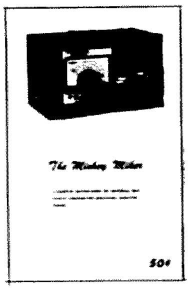
5) 38% felt it likely that they would buy a tower this year. Do you have any idea how many towers that is? Good grief. Our special tower feature section in May should be of considerable interest.

6) 82.4% have purchased some surplus during the last year. We'll have to run a special surplus issue this summer. No wonder 73 has more surplus advertising than any other magazine.

. . . Wayne

73 Products

Peterborough, N. H.



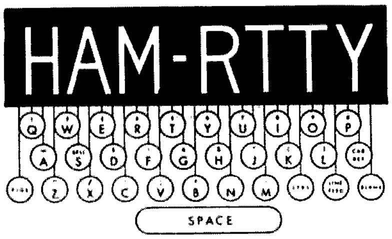
MICKEY MIKER 50c

Complete and exhaustive construction project for building a precision capacity tester. Very thorough.

IMPEDANCE BRIDGE PRINTS $1.00

A complete set of full scale prints (15) of all parts of the precision impedance bridge which originally appeared in the August 1961 issue of 73. Comes complete with a reprint of the original article.

NEW RTTY BOOK $2.00



This handbook is written for the beginning RTTY op, but due to the profusion of info, pictures, circuits, etc., it will be valuable to all RTTY'ers and those who may RTTY themselves. If you don't know what RTTY means don't buy it. For $2 what can you lose? It's worth almost that much in paper.

". . . wealth of info . . . a great help here in this shack . . ." W3AJD

". . . you should be congratulated on a fine job. It contains a great amount of the detailed sort of information that is useful in establishing Civil Defense circuits . . . I am suggesting it to the people that I work with as *recommended reading* . . ." W6QLB

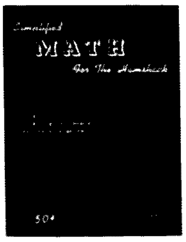
"How on earth did you ever get pictures of so many different types of RTTY equipment? This book was worth its weight many times over just for knowing what is what . . ." WA6EXU

"Boy, does your new RTTY book make the 'other' one look sick. Congratulations . . ." BJK . . . NY.

"It is . . . ah . . . ah great pleashah to read a book that has been written with such viggah . . ." JFK . . . DC.

In stock, immediate shipment, send Money. ONLY – $2.00.

SIMPLIFIED MATH 50c

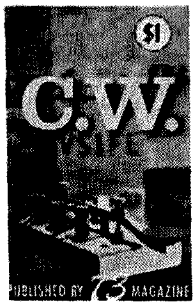


This booklet takes you gently by the hand and leads you through the mysteries of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc., and does it by an amazingly new method.

SURPLUS TV SCHEMATICS $1.00

TV'ers who are interested in saving a lot of construction time and still want to have elaborate TV gear will do well to watch those surplus ads and invest in this booklet, the only source of the diagrams you'll be needing.

CW $1.00



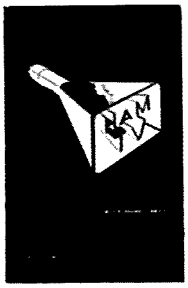
Written by an expert. One of the best methods for learning the code yet devised. Lays in a good foundation for later high speed CW ability. CW can be a lot of fun if you go about learning it the right way. This book will be invaluable to the beginner and the ham who wants to really increase his code speed.

AN/VRC-2 CONVERSION $1.00

CONVERSION
OF THE
AN/VRC-2
by
Lloyd Hanson, W9YCB

Exhaustively complete instructions on converting the surplus and inexpensive VRC equipment for six meter wide band FM ham net operation. Get thyself on 52.525 mc and join the national wide band FM activities.

HAM-TV $3.00

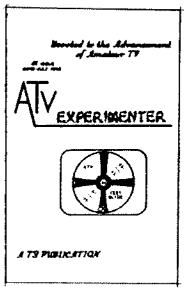


This book gives you a blow by blow description of how to get on the air on TV for under $50. This book is the reason that hundreds of hams are now going on TV. This is not the usual theory book, just a how-to-do-it manual.

SSB TRANSCEIVER $1.00

Extra large schematic diagram of this terrific little transceiver. Published originally in November 1961 issue of 73. Schematic comes complete with extra November issue.

AMATEUR TELEVISION EXPERIMENTER $1.00 per year

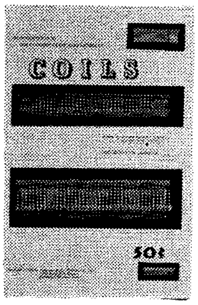


The first five issues of this invaluable bulletin are now in print. Each one is worth more than the year's subscription. Send $2 for complete set from #1 up through #12. Quantity limited so don't wait.

CARE AND FEEDING OF HAM CLUBS $1.00

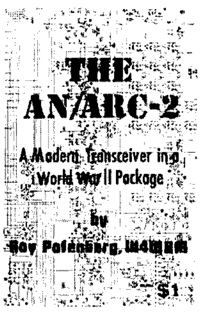
K9AMD's interesting book on all aspects of forming and holding together a ham club. This is the result of exhaustive interviews with many club officers and will be invaluable to every club going.

COILS 50c



Well illustrated basic book which describes all of the different types of coils to be found in radio work. Covers theory and practical aspects.

AN/ARC-2 CONVERSION $1.00



Complete schematics and thorough conversion details on this modern transceiver which covers 2-9 mc (80-40 meters . . . and 160). This unit now sells for $40 to $50 surplus and is easily converted into a terrific little transceiver.

WORLD GLOBE (plus subscription for one year) $16.95

Every visitor to the 73 HQ shack is taken aback by the beautiful world globe next to the operating position. We find this invaluable for figuring out beam angles and planning world tours. It is 18" in diameter, normally sells for $19.95 (via CQ), is nearly five feet around the equator. Canadians please allow a little extra for Diefendollar exchange.

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER THREE NUVISTOR PREAMPLIFIER for perfectionists, complete with self-contained power supply. Kit contains nuvistors, sockets, all condensers, resistors, potentiometers, power transformer, rectifier, switch, antenna coax connector, etc. See article in March 73 page 8. Everything you need, complete with full scale drilling template.
Kit W9DUT-1 . . . $18.50

PORTABLE RAGCHEWER RECEIVER. Simple little 40M regen receiver, but it works and is a lot of fun to build. Very portable. Kit contains all parts needed. See article in March 73 page 14.
Kit K6LJY-2 . . . . $16.50

PORTABLE RAG CHEWER TRANSMITTER. 6AU6-2E26 rig for 40M. Nice little 20 watt rig, VFO operated.
Kit K6LJY-1 . . . . $24.50

QRP TRANSMITTER. One tube (1S4) ½ watt 40M rig. Fun to build and really works. See article in March 73 page 22. We've built a lot of 'em here.
Kit W1MEL-1 . . . . $6.00

Radio Book Shop

Peterborough, N. H.

OK, how many times a year do you wish that you could look something up and frustrate yourself trying to find it in the back issues of ham magazines? . . . You need a handbook. The newest and bestest is the 16th Radio Handbook by Bill Orr W6SAI. This is terrific. It not only provides one of the best known ways to smarten up on your theory, but is jammed full of great construction projects. Look over this list and start building up your reference library.

1—ELECTRONICS & RADIO ENGINEERING—Terman. One of the most complete text books ever printed. 1078 pages. Theory, but easy on the math. **$15.50**

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. **$12.00**

11—16TH EDITION RADIO HANDBOOK—by Bill Orr W6SAI. This fantastic book is loaded with the most understandable theory course now available in our hobby plus dozens of great construction projects. This is the best ham handbook in print by a wide margin. Easily worth twice the price. **$9.50**

13—REFERENCE DATA FOR RADIO ENGINEERS. Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. **$6.00**

16—HAM REGISTER—Lewis (W3VKD). Thumbnail sketches of 10,000 of the active and well known hams on the air today. This is the Who's Who of ham radio. Fascinating reading. Only edition. Now only **$2.50**

18—SO YOU WANT TO BE A HAM—Hertzberg (W2DJJ). Second edition. Good introduction to the hobby. Has photos and brief descriptions of almost every commercially available transmitter and receiver, plus accessories. Lavishly illustrated and readable.. **$2.95**

21—VHF HANDBOOK—Johnson (W6-QKI). Types of VHF propogation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack.

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, to install it, how to tune it. **$2.70**

23—NOVICE & TECHNICIAN HANDBOOK—Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license and build a station. **$2.85**

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. **$2.85**

26—5-9 SIGNALS—Orr (W6SAI). A manual of practical detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. **$1.00**

27—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction, and operation of cubical quads. Build-it yourself info. Feed systems, tuning. **$2.85**

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. **$1.75**

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. **$7.50**

36—CALL LETTER LICENSE PLATE—Regulation size license plate. Please give your call and the color of letters and background. **$3.00**

37—101 WAYS TO USE YOUR HAM TEST EQUIPMENT—Middleton. Grid-dip meters, antenna impedance meters, oscilloscopes, bridges, simple noise generators, and reflected power meters are covered. Tells how to chase trouble out of ham gear. 168 pages. **$2.50**

45—CURTA COMPUTER. The world's smallest computer. Send for detailed information. Makes the slide rule look sick. Like a big Monroe computer only hand size. **$125.00**

48—BASIC ELECTRONICS—Covers subject completely. Written for use with RCA Institute training course. **$9.25**

49—ELECTRONIC COMMUNICATION—Shrader. Huge book aimed at giving all information necessary for FCC commercial and amateur licenses. **$13.00**

52—HOW TO READ SCHEMATIC DIAGRAMS—Marks. Components & Diagrams; electrical, electronic, ac, dc, audio, rf, TV. Starts with individual circuits and carriers through complete equipments. **$3.50**

53—BASIC ELECTRONIC TEST PROCEDURES—Turner. This book covers just about every possible type of electronic test equipment and explains in detail how to use it for every purpose. Testing: audio equipment, receivers, transmitters, transistors, photocels, distortion, tubes, power . . . etc. **$9.75**

55—TRANSISTOR CIRCUIT HANDBOOK—Simple, easy to understand explanation of transistor circuits. Dozens of interesting applications. **$4.95**

63—GE TRANSISTOR MANUAL—6th edition. This is one of the best buys around: 22 chapters, 440 pages, diagrams by the gross, data, facts, charts, etc. If you don't have this one you just aren't up to date. only **$2.00**

66—DESIGN MANUAL FOR TRANSISTOR CIRCUITS BY CARROLL. Tested transistor circuits for design engineers. Interesting reading too. **$9.50**

67—TRANSISTOR CIRCUIT ANALYSIS AND DESIGN by Fitchen. Written primarily as a college text to teach circuit design. **$13.00**

68—HANDBOOK OF TRANSISTOR CIRCUIT DESIGN BY PULLEN—This is a handbook which teaches a systematic system for transistor circuit design. Highly recommended by radio schools. **$13.00**

74—HANDBOOK OF ELECTRONIC TABLES & FORMULAS—Formulas & laws, constants, standards, symbols and codes. Math. tables, misc. data. **$2.95**

76—MODERN OSCILLOSCOPES & THEIR USES—Ruiter. Second edition. Shows what a 'scope is, what it does and how to use it for radio, TV, transmitters, etc. 346 pages. **$10.20**

80—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. 1 (second edition). This book gives circuit diagrams, photos of most equipment, and rather good and complete conversion instructions for the following: BC-221, BC-342, BC-312, BC-348, BC-412, BC-645, BC-946B, SCR-274N 453A series receivers conversion to 10 meter receivers, SCR-274N 457A series transmitters (conversion to VFO)SCR-522 (BC-624 and BC-625 conversion to 2 meters), TBY to 10 and 6 meters, PE-103A, BC-1068A/1161A receiver to 2 meters, Surplus tube index, cross index of A/N tubes vs. commercial types, TV & FM channels. **$3.00**

81—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. II. Original and conversion circuit diagrams, plus photos of most equipments and full conversion discussion of the following: BC-454/ARC-5 receivers to 10 meters, AN/APS-13 xmtr/rcvr to 420 mc, BC-457/ARC-5 xmtrs to 10 meters, Selenium rectifier power units, ARC-5 power and to include 10 meters, Coil data-simplified VHF, GO-9/TBW, BC-357, TA-12B, AN/ART-13 to ac winding charts, AVT-112A, AM-26/AIC, LM frequency meter, rotators, power chart, ARB diagram. **$3.00**

82—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. III—Original and conversion diagrams, plus some photo of these: 701A, AN/APN-1, AN/CRC-7, AN/URC-4, CBY-29125, 50083, 50141, 52208, 52232, 52302-09, FT-ARA, BC-442, 453-455, 456-459, BC-696, 950, 1066, 1253, 241A for xtal filter, MBF (COL-43065), MD-7/ARC-5, R-9/APN-4, R23-R-28/ARC-5, RAT, RAV, RM-52 (53), Rt-19/ARC-4, SCR-274N, SCR-522, T-15/ARC-5 to T-23/ARC-5, LM, ART-13, BC-312, 342, 348, 191, 375. Schematics of APT-5, ASB-5, BC-659, 1335A, ARP-2, APA10, APT-2.

88—EUROPE ON $5.00 A DAY—Europe can be just as expensive as the U. S. unless you know where to stay and where to eat. This book is the standard reference work for European travelers on a budget. This is the latest edition. **$1.95**

90—TELEPRINTERS, MODEL 31A—This midget, printer, complete with case, measures only 11" x 16" x 12" and is light enough to throw in the car for portable use. Complete with keyboard, ready to operate. **$100.00**

91—DIETZCEN 10" SLIDE RULE—This is the slide rule that is recommended in the book, "Simplified Math For The Ham Shack." With a little practice you'll have Ohm's Law whipped, and any other calculations too. Has C-D-C1-L-T-A-B-S-K scales. Beautifully made rule, complete with plastic case, looks like five times the price and works that way too. **$2.85**

92—QSL DISPLAY PLASTIC POCKETS—Each set of clear plastic pockets holds twenty QSL's for wall display. Keeps cards flat, clean and perfect. Keeps walls clean too. Or have you tried to hang QSL's yet. This beats *thumb tacks and Scotch Tape* all hollow. Comes in envelope of three to hold 60 QSL's, give it a try and you'll never use anything else. **Three: $1.00**

93—RADAR-TECTOR—This gadget, though designed to pick up police radar (which it does very efficiently we are told by several amateurs), also picks up two of our amateur UHF bands. Operates entirely from the 12v car battery. Regular price is $44.95. Bookshop Special **$28.95**

94—KIT OF SOLDERING TOOLS—Used to was a soldering iron was all that was necessary, now you have to have a kit of fool tools. Little doohinkies like scrapers, reamers, forks, and brushes. Forsooth! Made of varnished maple and spring steel (vastly superior to winter steel). **$4.87**

95—NE-PAD—Pilot-type writing desk that elastics to your pants leg for mobile log-keeping. Complete with two pads of 50 special 73 mobile log sheets. You know the logs gotta be good. Extra log pads are only 25c a pad. Ne-Pad with two log pads **$3.95**

ACR-1—ABC'S OF CITIZENS BAND RADIO—by Buckwalter. How to choose, set up, license and operate CB equipment. Discusses different types of rigs, receivers, antennas, how to tune, install, operate and troubleshoot. **$1.95**

ALP-1—CENERAL CLASS LICENSE HANDBOOK—by Pyle W7OE. A complete guide including typical questions and answers, to help you prepare for the FCC Technician, Conditional or General amateur radio exam. A good writer is quite a help in this sort of thing. **$2.50**

AMA-1—AMATEUR RADIO ANTENNA HANDBOOK—by Hooton W6TYH. Basic theory, construction and tuning of all the well known and effective ham antennas. Good stuff on feed lines and towers too. **$2.50**

AMP-1—TROUBLESHOOTING AMATEUR RADIO EQUIPMENT—by Pyle W7OE. A guide for all hams who want to keep their gear on the air by themselves. Includes complete schematics of many popular ham transmitters and receivers. **$2.50**

AMR-1—ABC'S OF MOBILE RADIO by Martin. Covers subject of two-way FM *mobile operation. Equipment, control,* range, power supply, receivers, transmitters, installation, and uses. Quite comprehensive. **$1.95**

ARN-1—ABC'S OF RADIO NAVIGATION—by Lytel. Complete info on navigational systems for small boat and plane owners. Covers Loran, Radar, Consolan, Decca, Gee, Omni, Tacan, Vortac, Ils, etc. Well illustrated, simply written and complete. **$1.95**

BEO—OSCILLATOR CIRCUITS—by Adams. This book is designed for the fellow who really wants to know how electronic circuits work. It is written with incredible simplicity and uses four color diagrams to effectively explain just what happens in circuits. Covers all nine basic oscillator circuits. **$2.95**

BON—FIRST CLASS RADIOTELEPHONE LICENSE HANDBOOK. Everything you need to know to get your 1st license. More than a Q & A book, you'll understand what it is all about when you get through this one. **$4.95**

EGT—ELECTRONIC GAMES AND TOYS YOU CAN BUILD. 15 Original games and toys, none available commercially. Test your steady nerves; your reaction time, battle a lie detector, etc. Guaranteed rouser. **$2.50**

ELW-1—ABC'S OF ELECTRONICS—by Waters. Sugar coated basics of electronics: the electron, magnetism, resistance, inductance, ac, impedance, radio waves, vacuum tubes, transistors, the oscillator. Excellent book for beginners. **$1.95**

G-93—RADIO CONTROL HANDBOOK by McEntee. This is the largest and most complete book ever published on the subject. 304 pages! It covers in detail every possible aspect of radio control. **$4.95**

G94—TRANSISTORS. Selected articles from Radio Electronics on how to test transistors and how to build all-transistor test equipment. **$1.95**

HAP-1—ABC'S OF HAM RADIO—by Pyle W7OE. How to get a Novice license. Excellent book by a top author. **$1.95**

MCN—MODERN COMMUNICATIONS COURSE—by Noll. Aimed more at commercial radio than amateur, but an excellent book for home study or class work. Covers transmitters and antennas quite well. **$4.95**

MMD—ELIMINATING MAN MADE INTERFERENCE—What makes it, how to find it, how to cure it in homes, factories, automobiles, aircraft, boats, etc. Or *maybe* you haven't been plagued lately. 160 pages. **$2.95**

NHP—BUILDING UP YOUR HAM SHACK—Pyle (W7OE). A practical discussion of points to consider when you are buying ham equipment, complete with descriptions of much of the available commercial gear. It's just possible that Pyle might keep you from making a mistake which would cost a lot more than his book. **$2.50**

QAN—2ND CLASS RADIOTELEPHONE LICENSE MANUAL—by Noll. Another 73 author makes it in the big time. Q & A manual for commercial ticket. Get one, you never know when it'll be handy . . . and this sure proves what you know, or don't know. **$3.95**

R261—MAGNETIC AMPLIFIERS. This new Rider book is a complete home-study course in M-A. Explicitly illustrated. We don't find M-A in ham use yet, but they are growing in industrial use as more engineers understand the applications of this relatively new device. 112 pages. **$2.45**

R262—BASIC TRANSISTORS—by Schure. Incredibly well illustratel book which sugar coats your way to understanding transistors. These little doohinkies been worrying you? Fret no more, read. **$3.95**

R235—RADIO CONTROL FOR MODEL BUILDERS—Winter. One of the best and newest books available on RC. **$4.25**

R245—HOW TO USE GRID-DIP OSCILLATORS—Tuner (K6AI). Construction & uses, an important book. **$2.50**

SIH—SSB COMMUNICATIONS HANDBOOK—by W6YTH. This book covers all known methods of generating SSB with details on them. Discussion and schematics on many popular SSB rigs. Very educational, and mostly for the ham. **$6.95**

SWL-1—ABC'S OF SHORT WAVE LISTENING—by Buckwalter. Covers what to listen to, frequencies, antennas, receivers, QSL's, space signals. Good basic cook for SWL'ing. **$1.95**

TCM—TRANSISTORS CIRCUIT MANUAL—by Lytel. Schematics and descriptions of over 200 transistorized circuits, covering just about anything you can possibly want to do with transistors. **$4.95**

731—HAM—TV—W0KYQ. This is the only book available on this fascinating branch of ham radio. Describes complete ham TV station that costs under $50. Very simple. **$3.00**

732—FULL SCALE PRINTS FOR MARK III IMPEDANCE BRIDGE FROM AUGUST 1961 ISSUE OF 73. These enlargements of the published scale drawings greatly simplify home construction of this terrific piece of test equipment. A complete copy of the original article is also included. **$1.00**

734—INDEX TO SURPLUS—Bibliography of all surplus articles printed in all radio magazines to date. Brief description, etc. **$1.50**

736—YEARLY BINDERS—for "73" Magazine October 1960 through 1961, or 1962. **$3.00**

738—SIMPLIFIED MATH FOR THE HAMSHACK BY K8LFI—Unbelievably simple explanation of Ohm's Law, squares, roots, powers, L/C, logs and the slide rule. No student should be without this booklet. **50c**

739—COILS by K8BYN—Wonderfully written and illustrated through discussion of coils, their resistance, reactance, impedance, Q, and distributed capacitance. **50c**

Send cash, check, money order or anything else we can easily take down to the bank to get them off our backs. Tear our pages and mark books you are ordering, or else jot a note of the numbers on a separate sheet. We also find it helpful when you include your name, call and address. Make check out to 73, Inc. (or to Wayne Green, Radio Bookshop, 73 Magazine, etc.). Don't make it out to CQ. We won't even get mad if you include $3.50 extra for a subscription or nenewal.

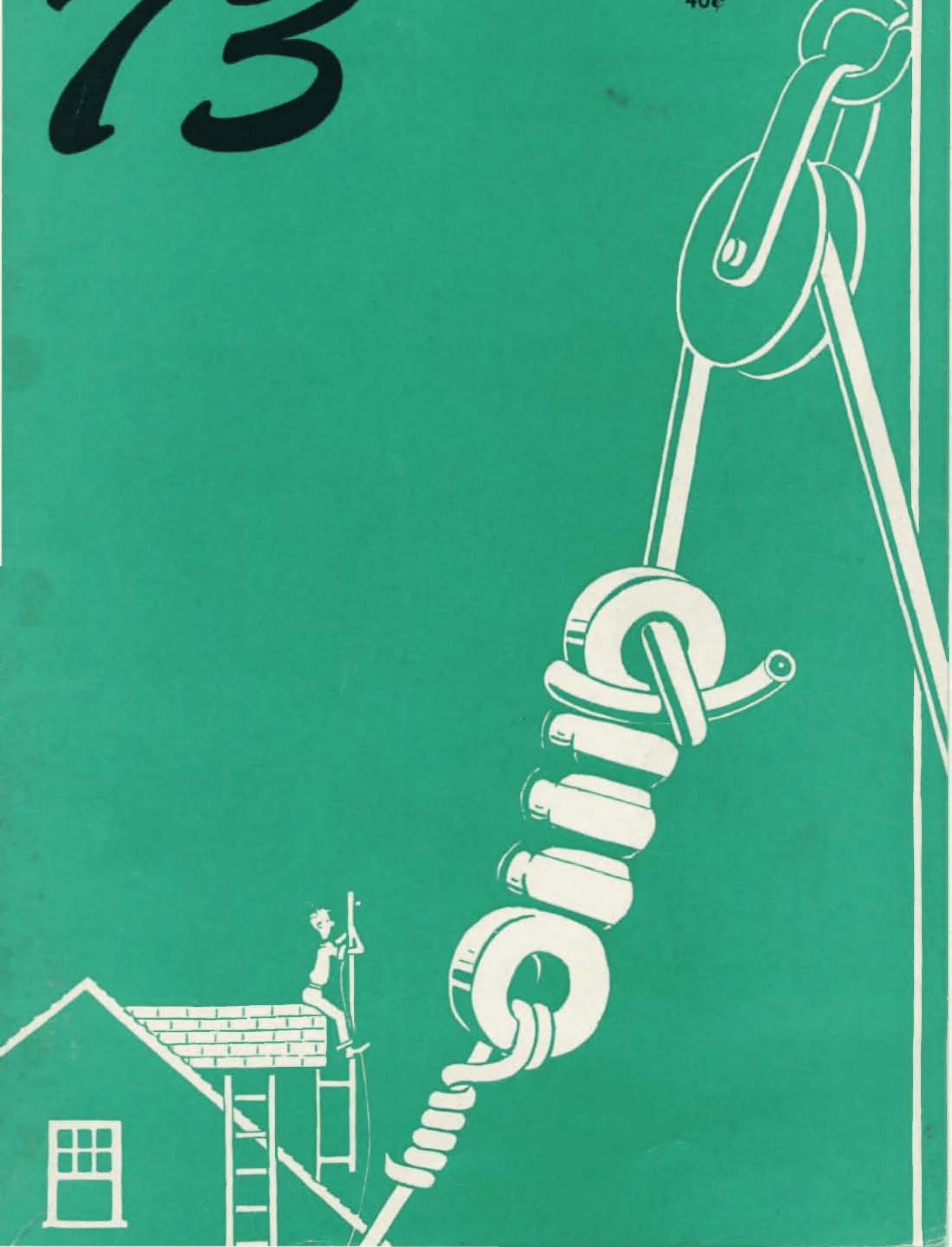
INDEX TO ADVERTISERS

To aid you in finding ads which are not running in this issue we have listed the last ad run by each company in 73.

AMATEUR RADIO

73

May 1963
An Insignificant
40¢



73

Magazine

Wain Green, W2NSD/1
Editor, etcetera

May, 1963

Vol. XIV, No. 5

Cover:
Bob Kelly, K2VLO

73 Magazine is published monthly by 73, Inc., Peterborough, N. H. The phone number is 603-924-3873. Subscription rates are still abysmally low at $3.50 for one year, $6.50 for two years, and $9.00 for three years in North America and U.S. possessions. Foreign subscriptions are $4.00 per year. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in the U.S.A. Entire contents copyright 1963 by 73, Inc. Postmaster: please send form 3579 to 73 Magazine, Peterborough, New Hampshire. Readers should stop reading the fine print and stick to the articles and editorial.

de W2NSD

Never say die

Notice to ARRL Members

It is now obvious that QST is going to keep beating the drums for their building fund until you all pay up. If you'd send in the money then QST could get back to their detailed operating news reports. After all, Egypt has its pyramids and China has its wall, so why shouldn't we have our ARRL Skyscraper? Get with it fellows; you joined the ARRL, now support it in its time of crisis. Of course this won't stop you from needling them a bit by marking your check out to the ARRL BUILDING FUND (73 WING). Send it to ARRL, West Hartford 7, Conn. Save just a little in case we get too jealous of the new building and have to have a shanty fund for 73 (we'd never be able to get enough for a building).

73 Parts Kits

My introduction of parts kits for our simpler construction projects back in March brought on mixed reactions. The readers wrote in complimenting us on the move. Some even went so far as to order kits, though not many. Remembering how long it took the Bookshop to build up steady orders I was encouraged that even twenty kits should be ordered the first month.

CQ, in an attempt to hurt us with the parts distributors, where my latest figures show we are outselling CQ by better than two to one, sent out a letter viewing the 73 kits with great alarm and worrying that we might shortly put parts distributors out of business. Though their intent was unfriendly, the result was very helpful for CQ's hysteria made many parts distributors aware of our kits and they were thus more disposed to go along with us on handling the parts kits through their companies.

It was obvious from the first we would not be able to finance more than a short test of the kit idea. You see, keeping our subscription rates and advertising rates very low keep us from making any money, so if something costs more than a few hundred dollars we have to forget it. The kit program won't make any money for anyone for a long time and I doubt if I could have convinced many parts distributors (or *any*) to participate without CQ's attack.

Now that we are getting better organized with the kits we will be looking into our back issues for good kit projects and will try to work up a good comprehensive kit list for you to select from.

April Cover

Old timers probably got a kick out of our April Fool cover last month. I am happy to report that the HQ gang seemed to enjoy it . . . see, they're not as stuffy as you thought. I did consider doing a parody of CQ, but couldn't think of anything funnier than they have now so turned my attention to QST.

Small Issue

We had planned upon running 128 pages again this month, but several factors interfered. For one thing the cost of running the 128 pages last month was considerably higher than had been estimated. Then I was laid low by a cold at advertiser harassment time and didn't get quite as many ads this month as I could have. And finally, Virginia, who does most of the work around here, had to take a couple of days off to have a baby. Next month we're going to have a really big issue, so wait it out. (It's a girl.)

(moron 4)

Europe!

The main topic of conversation around the 73 offices is the coming trip to Europe. Every time we hire a new employee we find them with their foot on the running board along about the second day on the job. Shirley, who is handling the subscriptions (and getting them straightened out pretty well, considering) is going to get her mother to substitute for her so she can go along. Pamela, our cute little bookkeeper, is already buying clothes for the trip.

The most worn books around here now are our old copies of "$5 a Day in Europe" (the new edition is due any day now) . . .$1.95 from Bookshop. Lee Gunther W6THN/1 of the Ham Hop Club has been dropping letters to the tourist bureaus for the countries we are going to be visiting and as a result we have been inundated with interesting literature about these countries, maps, history, etc.

We'll be visiting London, Paris, Geneva, Rome and Berlin. If you have to make just a short trip to Europe, these are the five most important places to see. The trip starts October 6th from Idlewild via Sabena and lands in London the morning of the 7th, Monday. We'll spend four days in each city, returning the 27th from Berlin.

In my past trips to Europe I've had the most fun staying at the second class hotels. These are immaculate and are where the bulk of the Europeans stay when they travel. They are usually less formal and you have a better chance to get to meet Europeans instead of Americans. Also it keeps the cost of your trip down amazingly. This makes it so we can fly the entire trip and have our hotel bills and breakfasts paid for much less than the usual tourist plane fare. For example, on this trip the plane fare normally would run $630 round trip. Flying in a group and economizing on hotels we can make the entire trip, including all hotels and breakfasts, for $550. Further, since we'll all be hams we'll all have a common interest which will make the trip a lot more fun than if we were all strangers.

I'm doing all I can to set up get-togethers in all of the cities we'll be visiting . . . but you can help by making a date with any DX ham you contact who can meet you there. If you get an invite to dinner accept it by all means for you will have a wonderful chance to get to know the foreign hams this way . . . and the people of that country.

This is not going to be an escorted tour . . . there will be no schedule for you to follow when you arrive in a new city. We'll give you

(From four)

all the info we can on what is most interesting to see, and where the best reasonable restaurants can be found . . . plus anything else we can think of that will help make the visit more interesting.

One thing I guarantee: you'll have a wonderful time on this trip and never forget it as long as you live. Even if you have to borrow the money, splurge this once. One chap is selling his car so he and his wife can make the trip. We will have enough room for all comers until about mid May. After this time please call or write to make sure we have enough room.

Since we are obviously going to be well filled up on this trip and probably with a good waiting list for cancellations. Thus I can guarantee you that we will be able to refund your money should you be unable for some emergency reason not to make the trip. Send $250 per person with your reservation, made out to the Institute of Amateur Radio. The balance will be due sixty days before the trip. This money is necessary for reserving planes, hotel rooms, busses, etc. See the editorial in the March 73 for more details. Send your reservation to 73, Peterborough, New Hampshire.

Galaxy 300

In line with our policy of having a minimum of at least one major error per page of the magazine I would like to report that there were two beauts on the sideband transceiver chart last month. The World Radio Labs Galaxy 300 uses a crystal lattice system and not phasing as reported. Somehow we got the two lines scrambled on frequency range and the Davco was shortchanged the six meter band, which was donated to the Drake. Give six back to Davco.

Next Month

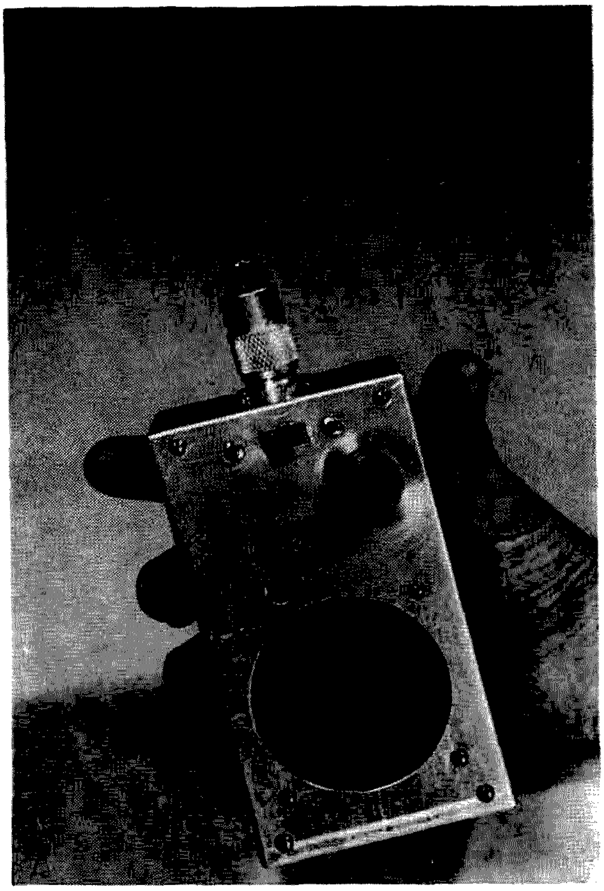
We've got another big issue coming up in June. This one will be aimed at the 83% of our readers who try their hand now and then at surplus conversions and buying. Some of the articles scheduled (we may not be able to cram them all in) are: BC-348, AN/DMQ-2, BC-230/BC-430, ART-26, RT-91/ARC-2, ARC-5, R-48/TRC-8, BC-453, BC-455, RT-45/ARQ-1, T67/ARC-3, R105A/ARR-15, R-508ARC, BC-442, PE-97A, PE-201A, etc. In addition to all these articles we expect up to 20 pages of special surplus ads which will make one of the finest surplus catalogs you've ever used. This issue will be quickly sold out, so don't miss out . . . subscribe.

(Skips to page 57)

Six Meter Ultra-Midget Transceiver

73 Parts Kit Available

Robert Kopski K3NHI
Philco Corporation
Lansdale, Pennsylvania

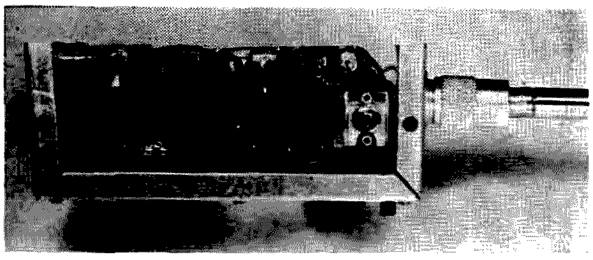


The new Philco MADT transistors, though inexpensive, have brought about a minor revolution in VHF equipment and permit, for the first time, really miniature equipment to be constructed. Two of the transceivers shown here were made to illustrate this application. The unit uses five transistors in a superregenerative receiver and crystal controlled transmitter and modulator.

While not designed for the DX'ing crowd on six meters, this little gadget has received over an 80 mile path using an inside dipole. The more usual range is about a half mile between two identical units using built-in whips. Considering the simplicity of the rig it is difficult to imagine why any amateur who occasionally travels wouldn't pack one of these little gems in his suitcase so he could get in touch with local hamdom.

Circuit

Q1 is a single transistor superregenerative



receiver! Perhaps just a word should be put in here in support of this type of receiver. Heath uses this in their Sixers for the circuit is not only extremely simple, but very sensitive. It takes quite a superhet to do better on sensitivity. Selectivity suffers, and you can have some real problems if a very strong signal comes on near your frequency.

The detector is reflexed in that detected audio is fed back to the base of Q1 through C2 and is amplified. The operating point of Q1 is established by R1, R2, R3 and R4. R4 controls the regeneration. Tuning is achieved by varying C5. C7, C8 and R5 form a low pass filter to prevent the quench signal from overloading the audio section.

The transmitter uses two transistors, Q2 a fifth overtone oscillator and Q3 the final class C amplifier running a mighty 50 mw input. The output is on the order of 25 mw, down somewhere in the microbe-power division.

The audio/modulator uses two transistors, RC coupled, and a permanent magnet speaker which doubles as a dynamic mike. The receiver output transformer primary is used as a choke for Heising modulating the final on transmit, giving a healthy 90% modulation. Neutralization of the final might permit slightly higher modulation. The D1-C21 circuit prevents high voltages from the Heising choke

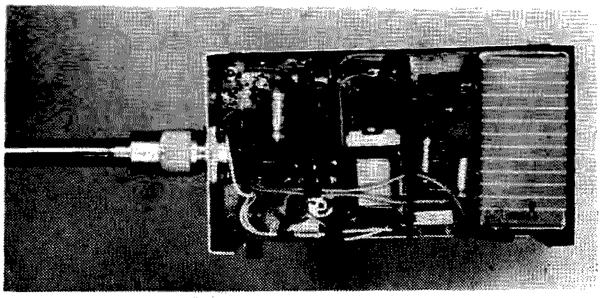
from damaging Q5.

A four-pole-double-throw switch transfers all the circuits. Power is supplied by the usual 9 volt battery. In this unit a 5¼" x 3" x 2⅛" aluminum minibox was used and the circuit was mounted on a piece of double-sided copper-clad printed circuit board. The double-sided board acts as a fine shield between the audio and rf circuits. This board is excellent construction material for it is easily cut, drilled and soldered to. Shields can be soldered to it, making an extremely rigid assembly.

The whip antenna was mounted using a coax connector (photo) so that other antennas could easily be connected for better DX. The whip can easily be permanently mounted on a plexiglass or micarta mounting plate.

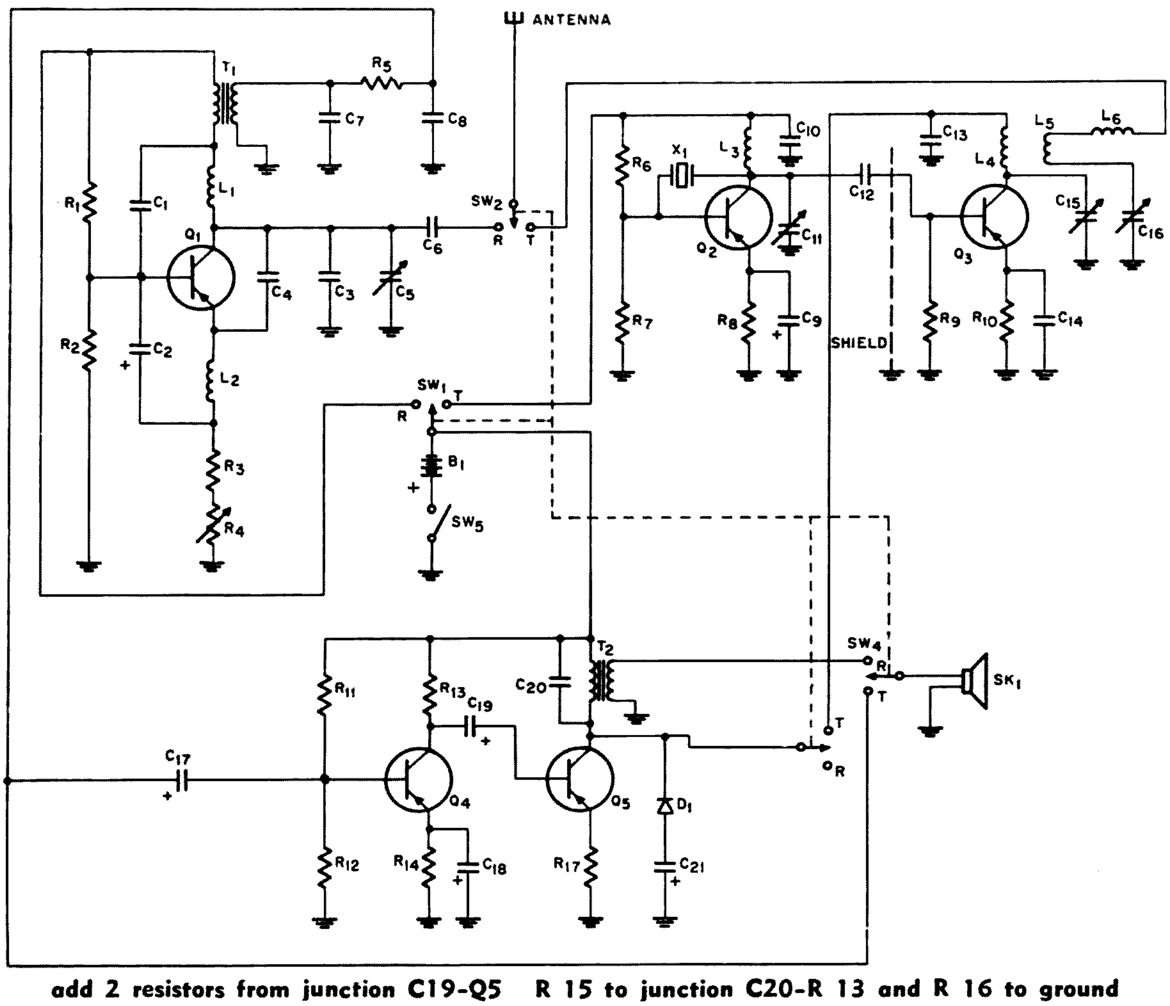
Tune-Up Procedure

The tune up procedure is straight forward. With S5 on, receiver regeneration control R_4 is adjusted for a strong rushing sound in the speaker. Final trimming of R_4 is best achieved while listening to an incoming signal. Capacitor C_3 may be adjusted slightly for bandsetting, and tuning capacitor C_5 should cover 2 megacycles of the six meter band. Quieting of the

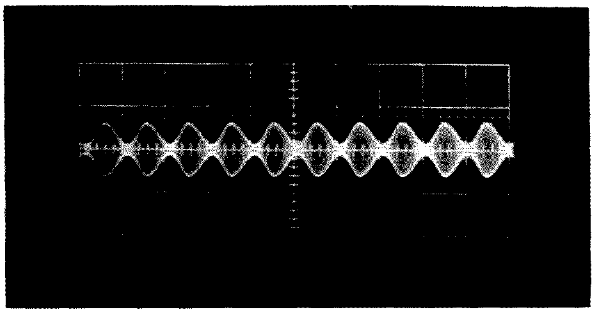


rushing sound should occur with an incoming carrier.

Transmitter tune up is also straight forward. The oscillator and final tank circuits can be initially set with a grid dipper. With S5 on, depressing the push to talk switch should cause immediate operation of the transmitter. Transmitter operation can be checked with a grid dipper, a field strength meter, or another receiver. If the oscillator fails to start when the push-to-talk switch is depressed, adjust C_{11} until it does so. Final transmitter adjustment is best achieved with the antenna fully extended and the case closed and held steady on a table with one hand. With a field strength meter nearby, adjust C_{11}, C_{15} and C_{16} for maximum output. Check to make sure the oscillator



add 2 resistors from junction C19-Q5 R 15 to junction C20-R 13 and R 16 to ground



Actual photo of the transmitter output modulated with a whistle and observed with a 100 mc scope. Note relatively clean envelope.

starts easily by depressing the push-to-talk switch several times. It should start each time. If it does not, back off on C_{11} slightly. Check for modulation by listening with another receiver. The signal should be crisp and clear. It is not necessary to hold the "mike" close or shout. Normal talking four to six inches from the "mike" should permit full modulation.

These little transceivers are a lot of fun, whether you pull them out at the local ham club meeting, talk all around conventions, meet hams in towns you are visiting, or even hook it up to your big beam and astound everyone. Reports of 5-9-plus have been consistently received over 20-mile paths with a four element beam. A little mountaintopping with this and a portable beam is a lot of fun and something you'll never forget.

. . . K3NHI

Table I

Receiver: dc input current	**15**	**ma**
Osc: dc input current	**4.5**	**ma**
dc input power	**40**	**mw**
Final: dc input current	**6**	**ma**
dc input power	**50**	**mw**

Parts List

(½ watt carbon)
R1—39,000
R2—12,000
R3—2200
R4—5000 pot
R5—3900
R6—10,000
R7—1000
R8—100
R9—1200
R10—22
R11—220,000
R12—10,000
R13—3900
R14—100
R15—47,000
R16—4700
R17—22
C1—100 mmfd
C2—2 mfd 10v elect.
C3—10 mmfd
C4—6.8 mmfd
C5—15 mmfd MAPC var. with 4 plates removed
C6—4.7 mmfd
C7—.01 mfd
C8—.05 mfd
C9—.002 mfd 50v
C10—.01 mfd 50v
C11—4-30 mmfd trimmer
C12—15 mmfd
C13—.01 mfd 50v
C14—.01 mfd 50v
C15—4-30 mmfd trimmer
C16—280 mmfd trimmer
C17—30 mfd 10v
C18—30 mfd 10v
C19—30 mfd 10v
C20—.01 mfd 50v
C21—30 mfd 25v
Q1, Q2—2N1499A
Q3—2N1749
Q4, Q5—2N2374
D1—1N34A or equiv.
SKI—2½" 3.2 ohm speaker
X1—6 meter 5th overtone HC6U type
ANT—52" telescopic antenna
L1—10 turns ⅜" i.d. #16 enam
L2—6.8 uh rfc
L3—8 turns ⅜" i.d. #16 enam
L4—8 turns ⅜" i.d. #16 enam
L5—2½ turns #20 hook up wire over L4
L6—9 turns #20 plastic hook up wire ¼" i.d.
T1—Calrad CR60 20K-1K or equiv.
T2—Calrad CR40 1.2K—3.2 ohms or equiv.
B1—9v Battery, Everready #246 or equiv.
SW—4PDT push-to-talk switch, Lafayette SW92

Good as New

W4WKM

Salvage TV sets and the junk box are the primary source of power supply components in amateur construction projects. There is a very good reason for this. What with the current price of copper and steel and high labor costs, the price of even a small power transformer makes a big dent in the budget.

However, from an appearance point of view, there is nothing quite so discouraging as a twenty year old chunk of rusty and scratched ironwork. It is quite simple to restore both inclosed and open frame transformers and chokes to good-as-new appearance. Simply scrape off the worst of the rust and brush the dust off. Get a can of Krylon #1602 flat black spray lacquer. Mask the transformer lugs and/or leads with masking tape and you are ready to go.

Shake the can well and apply a couple of liberal coats. You can cover the laminations shell and even the windings and insulation of open frame units since the lacquer is a good insulator. The finish drys in less than 10 minutes so that only a short time is required to paint all surfaces.

If the component leads are too short or in poor condition, splice on lengths of stranded, insulated wire and slide Vinyl sleeving insulation over the length of the leads. The finished product is almost indistinguishable from a new component and the improved appearance will raise the quality of your completed project.

A 6DJ8/ECC88 Converter for Six

Parts Kit Available, too!

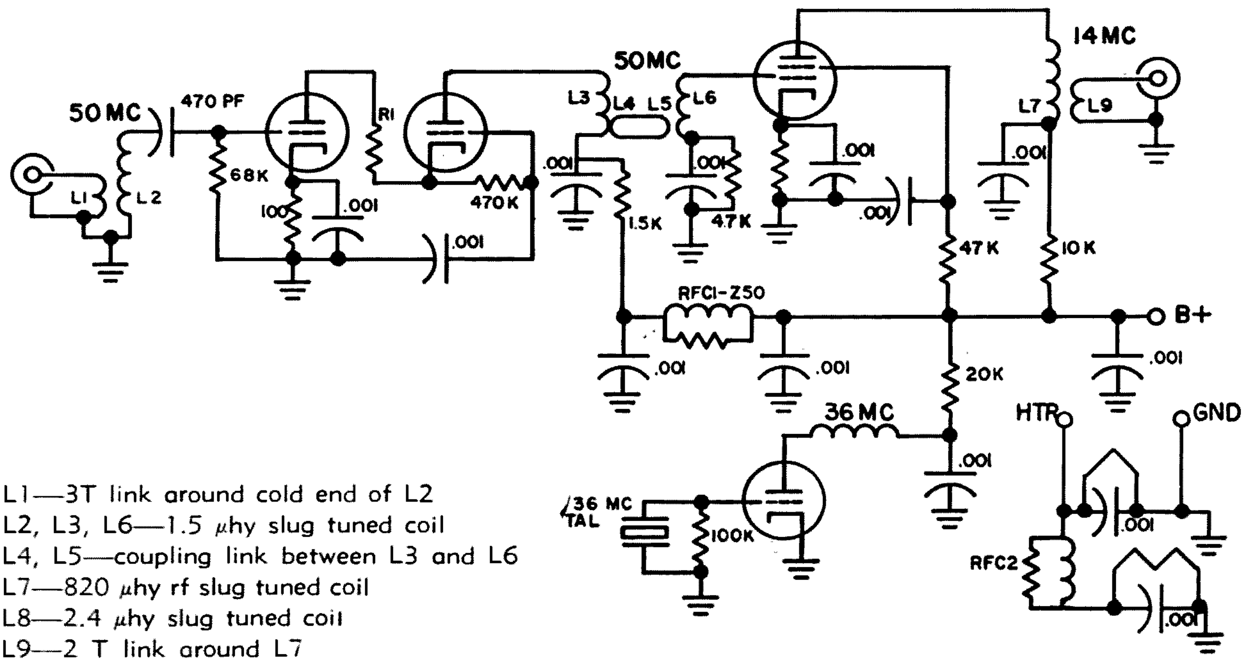
Bill Pasternak WA2HVK
1525 West 8 Street
Brooklyn 4, New York

In November of 1960, 73 published an article on improving the sensitivity and the signal to noise ratio of the Gonset Communicator III by replacing the 6BZ8 front end tube with a newly developed dual triode called the 6DJ8/ECC88. As a matter of fact virtual step by step instructions were given at that time to make this simple conversion. Anyone who did it realized an improvement in their equipment right away. Hence, you would think that this tube would be a natural for a converter article, but as fate would have it about this time RCA developed the Nuvistor, and a whole new trend in converters was started. Though many articles appeared using Nuvistors, the poor little 6DJ8 was all but forgotten. This held true until about a year ago when Clegg Labs brought out the now famous 99'er (see May 1962 73) and chose the 6DJ8 for the front end. After owning and operating one of these transceivers for about five months, I realized that they had made a good choice in the 6DJ8.

Since it had been about a year and a half since the last was heard of this tube it appeared that no one had taken the incentive to design a converter around this tube, so I did.

Construction

Basically this converter is quite similar to many others recently described. It is built on one half of a 2¼ x 2¼ x 5 Bud Minibox with the other half being used as the bottom cover. The 6DJ8 is used in a cascode circuit with neutralization being acomplished by R_1, a 12 to 25 ohm resistor and a shield plate that bisects the socket of V_1. The antenna is link coupled to the grid of the first section of the cascode amplifier as is the output of the amplifier to the mixer. This breaks a long standing trend toward capacitive coupling because of its ease of construction and lower cost. Although a little more difficult to construct, this system affords excellent image rejection and very good passband characteristics. In addition, because of the excellent isolation between the input



L1—3T link around cold end of L2
L2, L3, L6—1.5 μhy slug tuned coil
L4, L5—coupling link between L3 and L6
L7—820 μhy rf slug tuned coil
L8—2.4 μhy slug tuned coil
L9—2 T link around L7

and the output of the converter, it removes the need for trap circuits at the antenna usually found in most cascode converters. When laying out the chassis be sure that L_3 and L_6 are in the same plane about 1 inch apart. Then after ALL other wiring has been fully completed and checked for errors, install the link coil between L_3 and L_6.

The mixer stage is conventional and uses a 6CQ8 as a combined oscillator and mixer. A type 6U8A or 6EA8 can be substituted without any changes in circuitry. There is no difference in the sensitivity, however the 6CQ8 being a tetrode is less apt to overload due to a strong local signal. The output of the mixer is again link coupled to the output jack, J2. The *if* frequency chosen was 14 mc, and a 36 mc overtone rock was used in the conversion oscillator. The tubes own interelectrode capacity will afford plenty of oscillator injection as the tube was specifically designed for this use.

Alignment

Alignment is simple, all you need is a GDO. Pretune L_2, L_3 and L_6 to approximately 50 mc. L_7 should dip at 14 mc and L_8 at 36 mc. Now apply power to the converter and using the grid dipper as a wave meter adjust L_8 for slightly less than maximum output. Now tune in a weak station and tune everything else for maximum. You are now ready to go.

Results

While this is not the ultimate in converters, it does compare favorably with most of the Nuvistor jobs around today. According to the 6DJ8 specs the noise figure should be in the realm of 4 to 4.5 db. I can tell you that it has the ability to dig out the weak ones and make them Q5 copy, which is what counts.

. . . WA2HVK

George Thurston W4MLE

A Simple T-R Switch

Since I spend most of my operating hours as a CW traffic hound and gumbeater, and DX has been mainly an afterthought, I've used a separate antenna on the receiver for all of my 15 licensed years.

Recently with the DX contests coming up and with increasingly good performance on the lower frequency bands, I decided that the time had come to begin using the same antenna for transmitting and receiving.

A change-over relay was out of the question. They don't make 'em fast enough to follow a bug for full CW break-in. A T-R switch appeared to offer the solution—but the decision left me with misgivings about TVI, insertion losses, birdies, shot-noise from the final, inadequate protection to the receiver and all the other ills which T-R switches are supposed to be heir to.

All this aside, which circuit to choose?

The handbooks are full of them. Nearly every issue of every amateur magazine has another new (or old, or modified or better or different or simpler or more versatile) T-R switch.

Being an obstinate cuss, I set my head firmly against switches which:

(1) had to be bandswitched

(2) had to be tuned

(3) which cause insertion losses rather than gain.

The switch I wanted had to just hang in there and do its job with no more attention from the operator than the HV rectifier tubes.

I was commiserating with W4WHK on 80 M CW one evening about the Utopian nature of such aims and he offered the circuit he uses, developed by himself and W9PUH/K4PNS, but apparently not published and apparently not very radical.

Dave (W4WHK) sent the schematic. The switch took two evenings of puttering around the shack because the NCS kept interrupting in the middle of a solder joint to give me some more traffic.

Construction was the essence of simplicity because there's nothing critical about layout. In fact, there's hardly any layout. I built mine on a discarded, re-used and discarded again minibox of more than ample proportions. I built in a power supply because I dislike stringing wires all over the shack "borrowing" power from this or that piece of gear which somebody had the foresight to provide with a power supply.

The instructions Dave sent along said the circuit "will produce some gain in the overall system. 12AX7, 12BH7, 12AU7, 12AT7, 5814A, etc. can all be used. Gain varies with the type of tube used.

"Some lengths of coax (or combinations of lengths)," Dave continues, "tend to give some loss in the system and vary with the transmitter, receiver and antenna system. The right lengths have to be determined experimentally. Generally, the line length from the final to the T-R switch and from the switch output to the receiver tend to be the most critical."

So much for the theory.

Actually, I used the lengths of coax which were handy. They work. The switch produces a little gain. I left things alone. I haven't any idea whether other lengths of coax would work any differently. If you build the switch you can find out and let me know.

Since I run fairly high power (600 w to 1 kw on CW) I chose to put a third tube in parallel. I have no idea whether this is essential. W4WHK runs some 600 watts, uses two tubes in his switch and hasn't blown anything yet. I use 12AX7s because they were in the junk box. As an added precaution in the interest of receiver safety, I connected 1N34's back to back across the receiver antenna terminal connections. These diodes have *no* effect on the signal at the level used for receiving. However, when the forward voltage applied to them exceeds a few millivolts, the diodes conduct heavily, offering an effective short circuit to rf potentials of anything like damaging proportions.

So far the switch has met all my specifications.

Even with the minibox completely unbuttoned and no low pass filter in the line, there is no TVI.

I haven't experienced any birdies.

Although the 4-125As in the final draw 10 or 15 ma of idling plate current, I have experienced no difficulty with shot noise or similar effects.

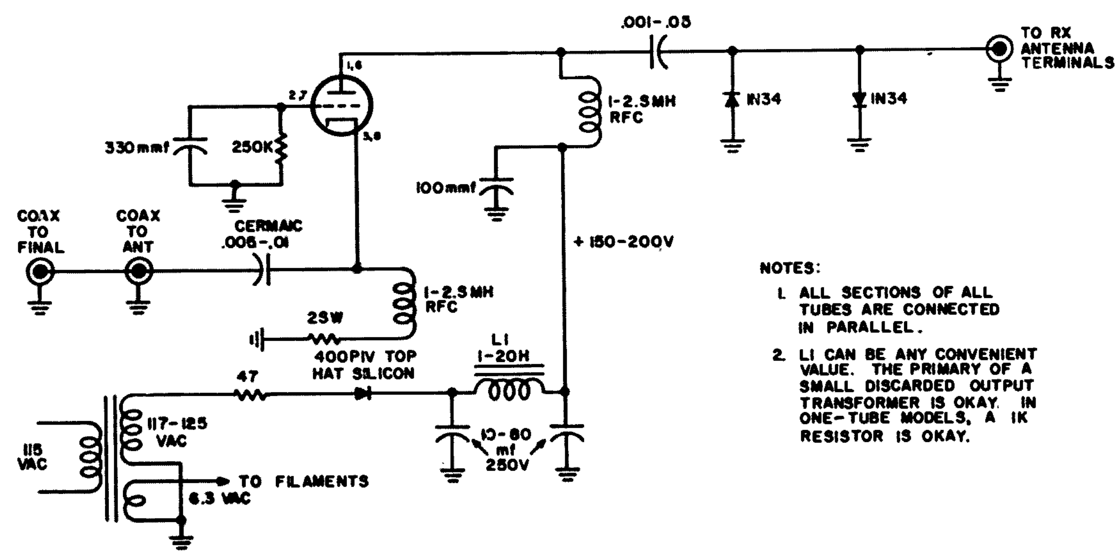
The switch works on 15, 20, 40 and 80 meters, without tuning, and provides gain on each band. Actually, tuning the transmitter final tunes the switch. There is a very perceptible increase in strength of received signals as the transmitter final tuning capacitor is rotated through resonance. In fact, I have used this for "rough tuning" the final before putting plate power on, with fairly close approximations of resonance.

Total cost of the project was nil. I had everything in the junk box except two coax connectors which I scrounged from a fellow-ham. Total cost if everything is bought new (how ridiculous!) would be somewhere between five and ten dollars—closer to ten if you include the power supply. Some saving in cost can be realized if phono-cable connectors are used to connect the switch to the receiver. The same type of connector can be used for low-power transmitters (probably anything from a pair of 6146's down) at another saving in cost. A coax "T" connector is *not* necessary. You can simply use another panel-type connector mounted in the T-R switch.

The unit could easily be built into a chassis along with an antenna tuner, SWR bridge, antenna switching circuit or similar device. It could even be incorporated into the chassis of a transmitter if space exists or a new one is under construction. There's a further saving in cost here, because it eliminates the need for a separate chassis and power supply.

Additional savings in cost can be achieved by using only one tube if the T-R switch is to be used strictly with transmitters in the 90-watt-and-under power category.

If I go any further, I'll be offering to pay you to build the thing, and I can't afford that, even with all the money I saved by building it myself. . . . W4MLE



Low distortion

All Band Linear Kilowatt

Bert Green W2LPC
George Phillips WA2PDI
Amperex Electronic Corp.
230 Duffy Avenue
Hicksville, New York

When designing a kilowatt linear amplifier that will handle a full gallon input as a sideband, CW or AM linear, the selection of the tube depends on the following:

A. The linearity of the tube without feedback.

B. The overall physical size of the tube, socket, and blower.

C. The overall cost of the tube, socket and blower.

In category A, linearity, the Amperex 8179 was rated for lowest distortion with the 3rd order I.M. products being down better than 40db in a grounded grid circuit.

Category B, size, showed up as a close tie between three contenders. While the Amperex 8179 was physically larger than the other tubes it was able to utilize a much smaller blower for cooling. The 8179 only requires a small flow of air over the surface of the tube which means that any small centrifugal blower may be used. The external radiator type tubes required a larger type blower to deliver the required air flow against the radiator back pressure.

In category C, cost, the 8179 was the lowest

priced tube by only a few dollars. However, the socket for the 8179 listed at 1/5 to 1/7 of the price of the sockets for the other two tubes. In addition the lower cost of the blower resulted in the 8179 tube, socket, blower price combination being much below the other choices.

Power Supply

The plate power supply is constructed on a 17 x 17 x 4 steel chassis enclosed in a perforated aluminium cover. The use of a choke input filter combined with silicon rectifiers and a husky transformer provide a power supply with extremely good regulation. Since the silicon rectifiers are used in series, each one is shunted with a one megohm resistor to equalize the inverse voltages across each diode. Being on the cautious side a few extra diodes were used to provide a safety factor.

A shielded cable, terminated in an Amphenol type 97-3106-28-410 connectors, carries primary power to, and high voltage from, the power supply.

Amplifier

The amplifier unit contains the rf amplifier itself, the bias supply, the screen supply, the filament supply, and the metering and control circuits.

The amplifier is a cathode driven, double grounded grid stage, with pi network input and output. A pi network was used for the input circuit for two reasons; first, it provides a proper impedance match between the 50 ohm input line and the 110 ohm input impedance of the 8179, thereby reducing drive power requirements.

The second reason for using a pi network input circuit is to reduce the harmonic input to the amplifier. In a grounded grid stage, the cathode impedance of the tube varies from a very high value to a low value at different points on the rf cycle. This causes a varying load to be presented to the driver and produces considerable second harmonic distortion. This second harmonic drive increases the plate input to the tube, but does not appear as usable output since the plate tank is an effective short at the harmonic frequency. This results in low tube efficiency and high plate dissipation. By driving the amplifier through a pi network input circuit, the amount of second harmonic appearing at the amplifier grid is reduced and the plate efficiency is increased, thereby producing more usable output for the same plate input.

The pi network used on the input of the 8179 amplifier is bandswitched to cover the 80, 40, 20, 15, and 10 meter bands and is designed to have a low Q in order to cover each band without the need for retuning. Trimmer capacitors on the input and output of the pi networks allows the SWR to be adjusted to close to 1:1 on each band.

The rf signal from the output of the pi is capacity coupled to the tube filament, while the 60 cycle ac power is fed to the filament by means of a B & W all-band bifilar filament choke.

The control grid is by-passed to ground by means of three Erie 1500 mmfd stand off capacitors connected in parallel to carry the rf current.

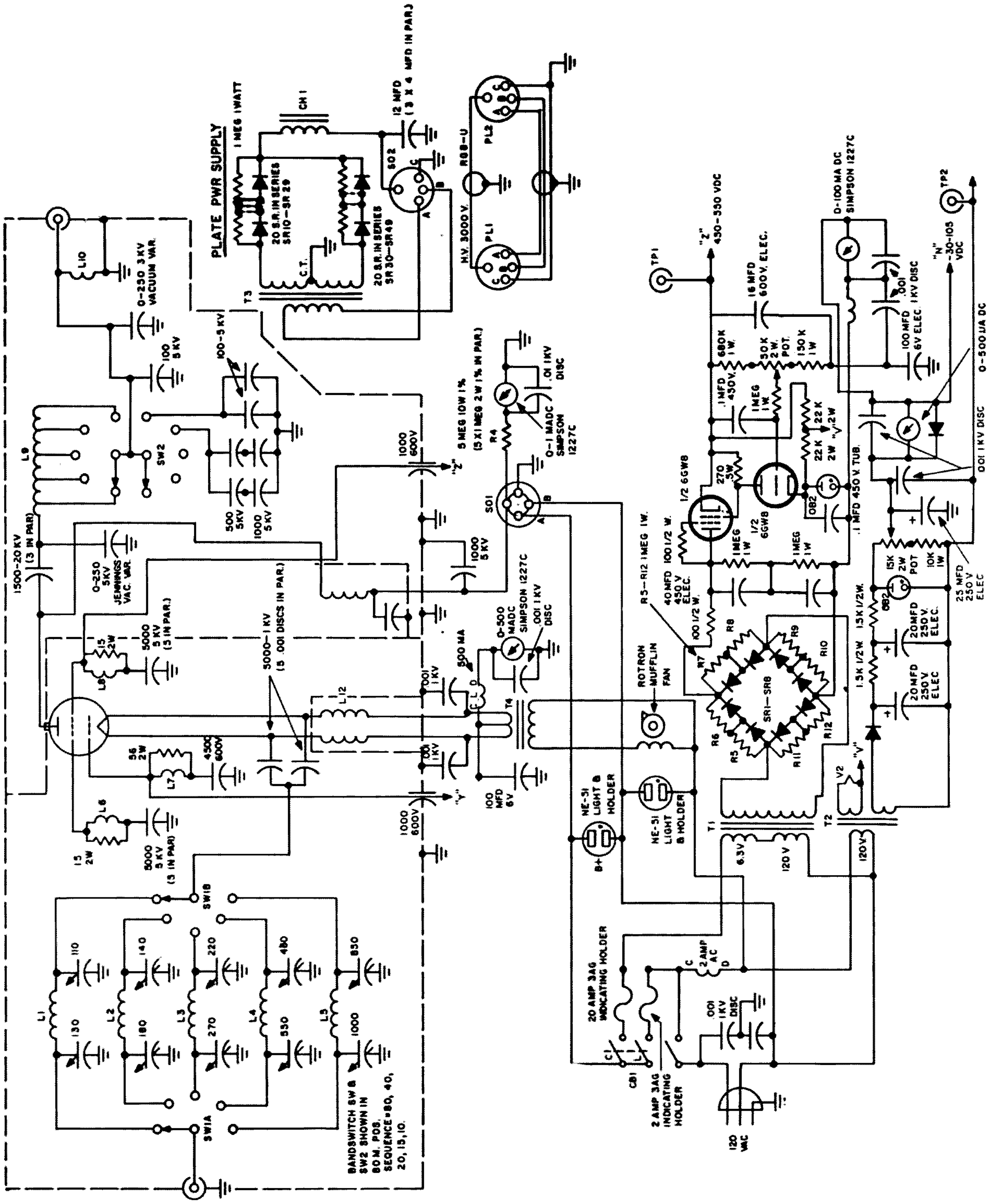
The screen grid of the 8179 is brought out to two pins and each of these is bypassed to ground by 5 Centralab 1000 mmfd transmitting capacitors in parallel. This was done because at 30 megacycles the output capacity of the tube is a large portion of the total tank capacity and much of the circulating tank current flows through the screen bypass capacitor.

The plate circuit is a bandswitched pi network constructed around a modified Illumitronix #P1 195-2 pi network inductor. A Radio Switch Corp. Model 86 rotary switch is used to change taps on the coil and on certain bands to place fixed capacitors in parallel with the variable loading capacitor. The plate tuning capacitor and the loading capacitor are 250 mmfd variable vacuum capacitors. The pi dux coil is modified by removing the 10 meter section and substituting a coil of 6 turns of ¼" copper tubing, 2¼" long on a 1½" I.D. The tapping points for the different bands were also changed. These changes were made in order to maintain the best L to C ratio for each band. The pi network is connected to the plate of the tube through a blocking capacitor made of 3 centralab 500 mmfd TV type high voltage capacitors in parallel. The B+ is shunt fed to the tube through a Raypar all band plate choke. Several homemade and commercial chokes were measured and the Raypar unit was found to have the best impedance characteristics over the desired frequency range. A Z-28 rf choke was connected from the output side of the pi to ground to prevent high dc voltage from appearing at the antenna terminals in case of a shorted blocking capacitor.

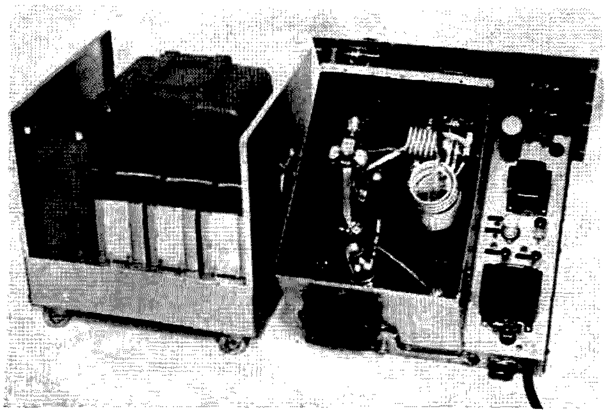
The grid bias supply is a simple half wave rectifier with a pi section filter and an OB2 VR tube. This provides a grid bias of 105 V which is stable and has very low ripple. Since

there is no grid current drawn from this supply, it was made variable merely by connecting a potentiometer across its output. A resistor is placed in series with the potentiometer to prevent the bias from accidentally being turned down to zero.

In a linear amplifier, in order to maintain low distortion, the screen grid power supply must be regulated. Ordinarily, this can be done with V.R. tubes. The 8179, however, draws more current than can be obtained from normal V.R. tubes, thereby, making necessary an electronically regulated screen supply. Electronic regulation generally requires considerable chassis space and can be quite expensive. For this transmittter, however, a regulator was designed which compares very favorably in cost and occupies less space than a



All values mmfd. unless otherwise specified



string of V.R. tubes would, even if they could handle the current. This regulator offers performance which is very much superior to the V.R. tubes plus the advantage that it is adjustable. The regulator consists of 2 tubes, 7 resistors, 2 tubular capacitors and a potentiometer. One of the tubes is an OB2 used as a voltage reference and the other is a 6GW8 triode-power pentode used as a series regulator and feedback amplifier. Power is supplied to the regulator by a Stancor PC8420 transformer and a bridge rectifier consisting of eight BY-100 silicon diodes and a single section capacitor filter.

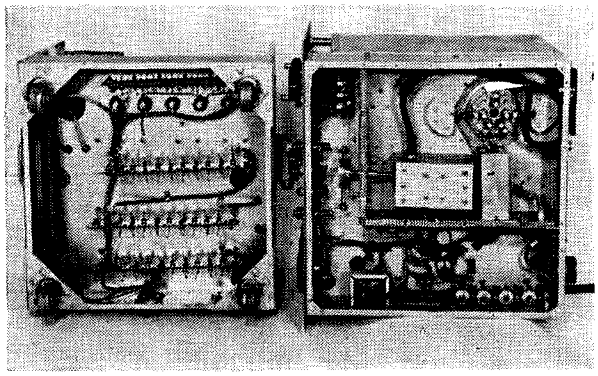
Four 2 inch meters allow for monitoring the operating conditions of the amplifier. Since the amplifier plate input is above 900 watts, both plate voltage and plate current meters are necessary to meet FCC regulations. The screen current meter in combination with the plate current meter allows the loading to be properly adjusted, and the grid current meter indicates if the amplifier is being driven beyond Class AB_1.

Full circuit protection is provided by fuses and a modified three pole Heinemann circuit breaker on the front panel. A Rotron muffin fan on the rear of the unit provides a small flow of air past the tube and tank coil. This is necessary since the amplifier is completely enclosed and would overheat unless forced ventilation was provided.

The amplifier is constructed on a 17" x 17" x 4" aluminum chassis with a 19" x 14" aluminum front panel. The rf amplifier is at one end of the chassis and is completely enclosed in an aluminum compartment to minimize TVI.

In the photograph of the top of the chassis, the top cover is left off allowing the component layout inside the rf section to be shown. Also, in the top view, the filament transformer and the bias and screen supplies can be seen.

In the photograph of the under side of the chassis, the bottom cover of the rf section is



also left off to show the components. This cover is made of perforated aluminum to allow air to be drawn up through the bottom, through the tube socket, around the tube and out through the exhaust fan in the rear. A few holes were also drilled under the tank circuit to allow some air to flow past the coil.

In the bottom view, a small enclosed box can be seen with a coax cable coming from the side and a shaft coming from the front. This is the input pi network which is ganged to the output pi network bandswitch by means of a pair of pulleys and a bronze dial cord. (The pulley arrangement is shown in Fig. 1).

The ten adjusting screws seen on the pi net cover are the input and output trimmer capacitors for each of the five bands and are adjusted for minimum SWR at the center of each band.

Spring fingers along the partition which encloses the rf section assure good contact to the perforated metal cover. The use of extensive shielding and by-passing of all leads entering the rf section minimizes TVI and reduces stray feedback from the plate to the grid, thereby increasing the stability factor of the amplifier. It also prevents rf from getting into the power supplies which can cause loss of regulation, damage to rectifiers, etc.

Between the upper shield compartment and the front panel, are mounted the two Johnson turn counting dials for the vacuum capacitors used in the plate pi network. Also, in this space is a plastic disc which rotates behind a window in the front panel. On the disc are numbers which show through the window to indicate which band is in use. The shaft which turns this disc is an extension of the band change switch and extends through the front panel to the band change knob. On this same shaft is the pulley which drives the bandswitch on the cathode pi network circuit.

The rf amplifier section is housed in a brown hammer-tone desk top cabinet with perforated top and rear covers. A square cutout was made in the rear cover to allow the muffin fan to protrude out of the back of the cabinet. A series of 2" holes were cut in the floor of the cabinet to allow air to enter the bottom of the chassis. On the rear chassis deck are the rf input and output connectors, the plate power supply connector, and the line cord.

When first placed into operation, the amplifier was found to parasite at about 120 mc. This could have been cured by placing a

TABLE I 8179 AMPLIFIER SINGLE TONE TEST DATA

Freq. (Mc.)	PWR Out (Watts)	Drive (Watts)	Test Conditions	No Sig.	Max. Sig.
3.75	960	34	E_b	3275 V	3100 V
7.15	910	33	I_b	165 MA	470 MA
14.2	920	28	E_{c2}	500 V	500 V
21.25	920	30	I_{c2}	8 MA	93 MA
28.8	900	29	E_{c1}	–87 V	–87 V
			R_L	—	3400 Ω

TABLE II PLATE TANK CIRCUIT CONSTANTS (Approximate Values)

Freq. Mc	Plate Tuning CAP Dial Setting [1]	mmf [2]	Loading Cap. Dial [1]	mmf	+ Fixed	Tank Q
3.75	0712	157	0519	156	760	12.5
7.15	1160	66	0927	64	300	10
14.2	1300	38	0714	118	100	11.5
21.25	1587	27	0215	217	100	12.5
28.8	1362	31	0640	133	100	19

Note 1. Dial set to 000 at Max Capacity (Tune Max. = 272 mmfd, Load Max. = 257 mmfd). Dial Settings are approximate only and will vary somewhat with different capacitors.

Note 2. These values do not include tube output capacity.

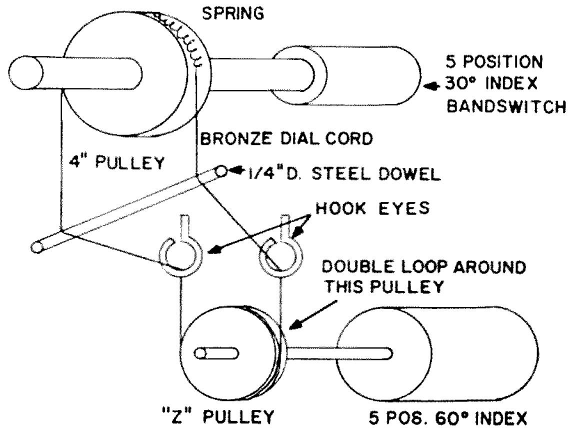
parasitic suppressor in the plate lead of the tube, but this would have inserted considerable resistance in series with this lead at 30 mc. Due to the high output capacitance of the tube, a good portion of the plate tank current flows through the tube and any resistance in the plate lead would cause high losses resulting in low tank circuit efficiency at 30 mc. For this reason, parasitic suppressors were placed in the control grid and screen grid leads instead of the plate. Since much of the plate tank current flows through the screen, the amount of resistance inserted in the screen lead was kept to a minimum, while the resistance inserted in the control grid was allowed to be as large as necessary to prevent the parasitic. This introduces some loss in the grid circuit, but in this manner high plate tank efficiency is maintained at the expense of a small increase in drive power.

The amplifier was tested into a 50 ohm dummy load on all bands for drive requirements and power output. The results of these tests are shown in Table I.

Table II shows the approximate capacitances, dial settings and Q used for the plate tank circuit at the center of each amateur band.

A test was also run on seven megacycles with a two tone signal to determine the amount of distortion present in the amplifier. The conditions were as in Table III.

When the amplifier was first constructed, the distortion was found to be quite bad (about −30DB). This was caused largely by the fact that the current meters and the circuit breaker coils in the negative leads of the power supplies were not bypassed for audio frequencies, causing an audio voltage to be superimposed on the power supply voltages. By bypassing the meters and circuit breaker coils with electrolytic



BANDSWITCH GANGING ARRANGEMENT

FIG. I

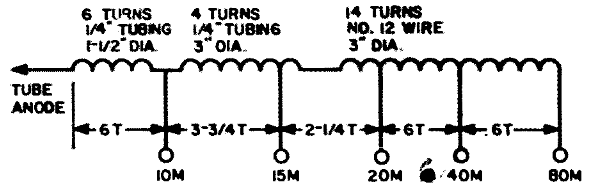


PLATE TANK COIL

capacitors, the distortion was decreased considerably.

The distortion was decreased still further by leaving the unused turns on the plate tank coil unshorted when switching from band to band, instead of shorting them as was done when the amplifier was first constructed.

The 8179 data sheet states that the tube must be operated in a vertical position only. During testing, the amplifier was operated on its side and it was noted that the distortion figures became slightly degraded. This is normal and is probably caused by misalignment of the control and screen grids due to sagging of the elements when the tube is operated on its side.

General Linear Amplifier Design Considerations

In designing a low distortion linear amplifier for a tube such as the 8179, certain precautions must be taken to maintain low distortion and reasonably high efficiency. Some of these apply primarily to the 8179, while others are general in nature and apply to the design of any linear amplifier. Some of these precautions are listed below.

1. Any impedance in series with the power supplies must be bypassed for audio frequencies as well as rf. The power supplies themselves should have good audio regulation, i.e., a large filter capacitor across the output.

2. Some means should be provided in grounded grid amplifiers for suppressing the second harmonic component in the drive signal. This can be done with a pi-network or other tank circuit tuned to the fundamental, a low-pass filter with a cut-off just above the operating frequency, or a series tuned second harmonic trap to ground. The pi-network and tapped coil methods also have the advantage of matching the line impedance to the tube input impedance, thereby reducing drive requirements.

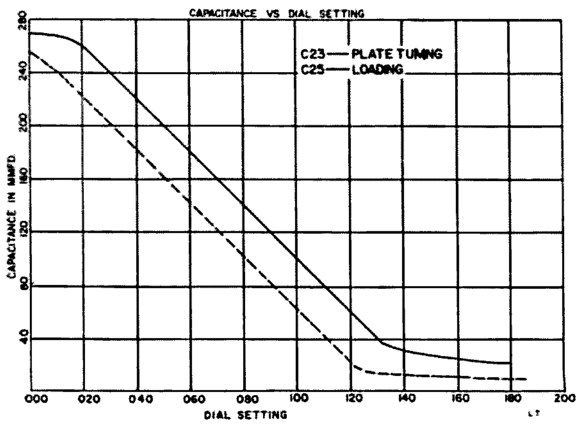


TABLE III 8179 AMPLIFIER 2 TONE TEST DATA

	ZERO SIGNAL	MAX. SIG. (2 Tone)
F	——	7 + 7.002 MC
E_b	3275 V	3150 V
I_b	165 MA	330 MA
E_{c2}	500	500 V
I_{c2}	8 MA	36 MA
E_{c1}	−87 V	−87 V
R_L	–	3400
PO (AVG.)	–	460 Watts
PO (Peak)	–	920 Watts
D3	–	−42 DB
D5	–	Better than −45 DB

3. The screen and control grid power supplies should be well regulated since a slight change in operating point produces a considerable increase in distortion. For instance, if the no signal plate current of the 8179 is changed 5 ma from the nominal 165 ma, the distortion increases 2-3 db.

4. The exciter distortion should be kept as low as possible. The exciter distortion should be at least 20 db better than the amplifier distortion in order not to increase the amplifier distortion by more than 1 db.

If extra drive power is available, the nonlinear loading of the driver by a grounded grid amplifier may be reduced by swamping the driver output with a resistive load.

5. The plate tank coil should be progressively opened instead of shorted when changing bands.

6. Parasitic suppressors should, if possible, be kept out of the plate tank circuit in order to keep the unloaded Q and, therefore, the plate tank efficiency as high as possible. At high frequencies, where the tube capacity becomes a good portion of the total tank capacity, this precludes the use of the normal parasitic suppressor in the plate lead. As much of the suppression should be done in the control grid circuit as possible with only as much suppression as is absolutely necessary in the plate and screen circuits. Suppressors should be made with the lowest values of resistance and inductance that will suppress the parasite to avoid excessive loss on the operating frequency.

Conclusion

The excellent performance of the 8179

linear amplifier shows what can be done in designing a low distortion, high efficiency amplifier by following the above recommendations and by using an extremely linear tube, designed specifically for single sideband use, such as the 8179. . . . W2LPC

L1—.38 μHY 8 Turns #406 Air Dux
L2—.49 μHY 9 Turns #408 Air Dux
L3—.75 μHY 11 Turns #410 Air Dux
L4—1.4 μHY 18 Turns #510 Air Dux
L5—2.8 μHY 12 Turns #616 Air Dux
L6, L7, L8—3 Turns #14 Wire Wound on R1, R2, R3
L9—Plate Tank Coil Illumitronic Pl Dux #P1 195-2 Modified as per Figure 11
L10—RF Choke OHMITE Z28
L11—Raypar All Band Plate Choke
L12—B & W All Band Filament Choke 25 Amp.
T1—Stancor PC-8420 Transformer
T2—Stancor PA-8421 Transformer
T3—U.T.C. Type CG307 Transformer
T4—Triad F-28-U Transformer
CH1—16 HY 300 MA Choke (2 x U.T.C. 5-33 in series)
SW-1—2 Pole 5 Pos 60° Index Rotary Switch, CENTRALAB #P-275 & (2) #Z-D
SW-2—2 Pole 5 Pos 3° Index Rotary Switch, Radio Switch Co. #86
CB-1—Circuit Breaker Heinemann Electric #XAM 666 Left Coil—500 MA DC Inst. Center Coil—75 MA DC Inst. Right Coil—2 Amps. AC Curve 3 Modified by removing companion trip connection between center and right poles.

Reducing Receiver Noise

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From time to time construction articles appear in the various publications dealing with the technical aspects of Amateur Radio. This suggests that amateurs are dissatisfied either with the price or with the performance of commercial receivers. Perhaps both.

A common frustration arises when we attempt to tune in that elusive DX station. As we raise the volume the noise level rises also. We reach a point of diminishing returns and give up. If we cannot read them we cannot work them.

Of course we have assumed that the noise originates somewhere "out yonder" and is all coming in via our antenna. That our receiver generates most of this noise has not occurred to many of us.

It is the purpose of this short paper to discuss this problem and offer suggestions whereby a receiver, either factory built or home-brew, may be greatly improved. The "practical" ham is invited to skip theory, if he must, and come back to learn the WHY after he has grasped the HOW of receiver noise reduction.

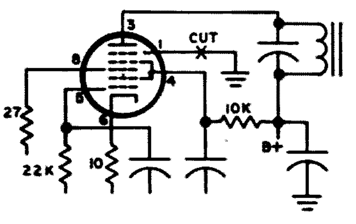

FIGURE I

Cut socket terminal 1 loose from terminal 2 and from ground and connect directly to socket terminal 6.

Consider the vacuum tube. Positively charged ions, either emitted by the cathode or produced by the collision of electrons with residual gas molecules, produce noise in this manner: since the ion is some 1800 times heavier than an electron it moves sluggishly and remains in the electron stream for a finite period of time before being neutralized by combination with an electron. These positive charges affect the electron stream in an erratic, or random, manner; both when appearing and also when disappearing.

Electronic devices, including tubes, transistors, rectifiers and the like, are essentially diodes through which current passes. Multigrid tubes which combine several "diodes" in one envelope are notoriously noisy. Every component carrying current is a potential noise generator.

Since ions are produced by collision of electrons with gas molecules, we should reduce all B plus voltages below the ionization potential of the gas left in the vacuum tube. To those accustomed to think of ionization voltages in terms of "runaway" tubes, neon lamps, and voltage regulator tubes, it may come as a surprise that B plus voltages must be reduced to a maximum of 18 volts, or less. Remember that in noise reduction, we are not concerned with "breakdown" or "avalanche" effects.

There is always a certain amount of leakage current, either from one electrode to another or to ground. This, together with that which we have called "diode" current, is reduced when we reduce the voltage applied to the tube.

In superheterodyne receivers a large part

of the noise originates in the two oscillator circuits. This is mixed with the desired signal and passed along for further amplification. This suggests that noise be minimized in the two, or more, oscillator circuits.

Each stage not only contributes its own quota of noise but also amplifies any noise from previous stages. It follows that the front end is the most likely part of the receiver to begin attempts at noise reduction.

Think of the cathode of each tube as the ground return for all circuits associated with that particular tube. Contrary to accepted practice each cathode should have its own insulated ground wire connected to a single point on the chassis, either directly or through a suitable capacitor. For example, if more than one tube is grounded through one wire, current flowing through one tube will be directly coupled into the other tube's circuits through the common ground wire. What is not so obvious is the fact that the chassis may act in the same manner if used as a common ground connection for two, or more, circuits.

Each stage should be shielded from its neighbors by putting each component associated with a tube in its own metal box. All by-pass capacitors should be grounded directly to the cathode socket terminal using a minimum length of wire. Ceramic disc capacitors have long leads which should be shortened to ¼", wherever possible. Tube layout should be such as to keep control grid lead lengths to a minimum. If other, more important, considerations make this impractical, run the grid lead through shielded braid and connect the shield, not to the chassis but to the cathode socket terminal of the tube being driven.

While physicists and radio engineers have known all this (and more) for years, very little of this valuable information has been applied practically. Manufacturing costs must be kept to an absolute minimum. "Good enough is best" appears to be the motto of the industry. This means whatever minimum of performance the trade will accept. For the "do-it-yourself" builder no such motto need apply.

Recognition of the various sources of noise will suggest methods of dealing with them. For example, consider the noise produced by ions in the electron stream. Having previously reduced all B plus voltages, if the cathode temperature is slowly reduced a point will soon be reached where ions no longer will be emitted. Electron emission, though reduced, will continue. It has been found by experiment that the best signal-to-noise ratio occurs at

about 75% of the manufacturer's rated heater voltage.

At this juncture we can imagine you, the reader, saying: "What good will this do me since I live in a noisy location?" We live in an apartment house, one door from State Highway 17. A power line runs along on our side of the highway. The roof of our building bristles with TV antennas, some connected to radiating TV receivers. We suspected that much of the hash was coming in over the power circuits. An effective line filter was constructed which reduced a part of the interference. After this it became possible to hear lesser sources of disturbance. We located two, a farmer's fence-charger, a couple of miles away, and an intermittent power leak where a wild grape vine had chosen to climb into a mess of wires on a utility pole. These were reported to their respective owners who were glad to co-operate promptly.

"Dirt" has been defined as "matter out of place." In like manner "noise" may be defined as "signals out of place." Our problem of "noise reduction" changes its appearance. It has become a matter with which we are more familiar; signal control.

There is a simple test anyone may make to check the noise produced by a receiver. With the antenna and ground leads disconnected, connect the receiver antenna and ground terminals together. A dime will do nicely. Now turn the rf and audio gain controls to maximum with avc control in the OFF position. Turn the AM-CW switch, if any, to the CW position. The noise, issuing from the speaker, did not come from outside. It was manufactured inside the receiver.

In case your receiver has been hissing at you it is easy to determine where most of the noise comes from. With gain controls full on try removing tube after tube, beginning with the rf amplifier, until the noise is sufficiently

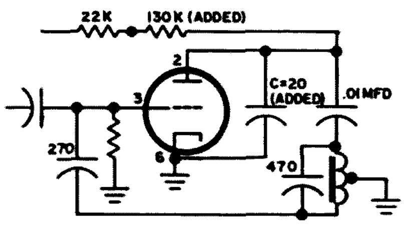

FIGURE 2

After adding resistor and condenser as shown retune pitch control to 455 KC by removing knob and turning shaft with pliers.

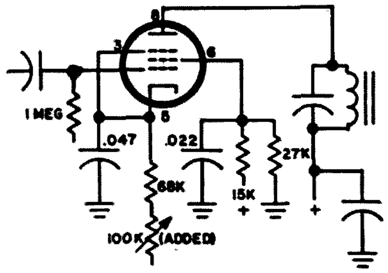

FIGURE 3

After determining proper maximum and minimum values with the 100 K ohm variable resistor it should be replaced with a fixed resistor of the minimum value and a variable resistor in series with the proper value to cover the entire range. One of the gain controls may then be replaced with a dual control to enable the operator to make front-of-panel adjustments possible.

reduced to be acceptable. The noise reduction which usually follows the removal of the converter tube has led to the erroneous belief that little, if any, noise reduction will follow the use of better tubes or circuits ahead of the converter, especially on frequencies below thirty megacycles. Let us repeat, this belief is erroneous.

The studious investigator no doubt has observed that much of the noise seems to come from the bfo and from the converter. We acquired a second-hand SX99 which had been modified by the previous owner. Having this to work with we decided to find out if theory would be verified by actual experiment. For it became evident that this receiver, like many others, had been producing plenty of noise without outside assistance.

Let us re-examine the circuit of the BFO. We found it was feeding much too much power into the *if* strip. Enough, in fact, to block the receiver completely when the avc was turned ON. The "gimmick" capacitor was reduced to a minimum by cutting the lead from the bfo back to the shield braid and by placing a wire as a shield between this lead and the *if* transformer. Bfo output was reduced further by feeding voltage to it through 150K ohms instead of 22K ohms. Finally a 20 mmfd capacitor was connected between plate and cathode at the socket and the circuit then retuned to 455 kc. While this greatly reduced strong signals and also strong noise it had very little effect upon weak signals. Most evident of all, it reduced the hiss appreciably.

Since a large part of the noise appears to come from the bfo and the converter let us re-examine their circuits. Turning to the converter circuit it was noted that the suppressor grid, instead of connecting directly to the

cathode (as it should), was connected to the chassis. Since this violated two basic theoretical considerations it was cut loose from the chassis and conected directly to the cathode socket terminal.

Returning to a physical examination of the converter circuit, as modified by the previous owner, an OB2 had been installed to stabilize the voltage to plate and screen circuits and thus reduce drift. A 0.0047 mfd ceramic disc capacitor, which we connected directly across the OB2, resulted in still further quieting. However, this had the adverse effect of preventing the converter from functioning on the *low* frequency end of band four. It was found necessary to introduce a 1000 ohm isolation resistor between the OB2 and the converter circuits to restore it to normal.

We would like it known that noise reduction followed each change. This was evident to the ear as well as by the built-in S meter. Between changes a foot long antenna was connected in place of the short from antenna terminal to ground terminal. This was done to make sure that received signals were not being reduced along with the noise. Finally the receiver was connected to an outside vertical antenna, 22 feet high, for further tests under normal working conditions. Truly, we were amazed!

It was decided to carry decoupling of stages a bit farther than had been done at the factory. The rf amplifier stage was decoupled by adding a 0.5 megohm resistor in series with the 1.0 megohm connected to the control grid of the first tube. Then the junction of these two resistors was connected, through a 0.0047 mfd disc capacitor, to the tube cathode at the socket. Although this resulted in some further improvement, in some positions of the rf gain control the receiver would motorboat accompanied by flickering in the OB2. In spite of this (or perhaps because of this) we decided to similarly de-couple the first *if* tube.

Then the unforeseen occurred! We installed the second decoupler, using a 2.2 megohm resistor. When we tested the receiver, regardless of any adjustment we might make, silence reigned and the S meter indicated zero current. We were about to disconnect the receiver and open it up when a weak signal came from the loud speaker, but with absolutely no noise! Although we had anticipated a little noise reduction, we were unprepared for total elimination of noise as it seemed we had achieved. Upon turning both rf and audio gain controls wide open, however, many other stations leaped out at us, accompanied by very little

noise. We had stumbled onto a circuit that was bringing in signals from all over, with a minimum of noise.

Although we were using a loud speaker the volume left much to be desired. It would have been ample for headphone reception but we wanted to use a speaker and avoid being tied to the set.

We thought that the 2.2 megohm resistor was too large and that volume would be increased if a resistor of lower value were substituted. In order to learn its exact value a 100K variable was connected across the 2.2 megohm resistor. We were surprised to learn that the signal-to-noise ratio could be varied over a considerable range merely by turning the 100K rheostat very slowly in one direction through its range while rocking the rf gain control. Those of you who have had experience with old time two or three dial tuners will understand what we did.

We were delighted with the way the reciever now operated. But we became less and less happy because we did not understand the reason for its greatly improved performance. After much thought on the subject it was finally assumed that in some, as yet, unknown manner, we had goofed while making the next to last change. Once this unflattering, ego-deflating idea was accepted it was easy to surmise what the goof might have been. Examination of the base diagram of the tube, a 6SG7, showed that we must have connected our second de-coupler circuit, not into the grid return circuit but into the cathode return circuit of the tube. By making this goof we had unwittingly verified the theory by greatly reducing all B plus voltages, as measured from the cathode.

Close examination of the socket terminals showed us just how the goof had occurred. The manufacturer had joined terminals one and two together and connected both to the chassis as a unit. We had counted the two as one! What we had counted as pin terminal number four was actually number five!

The most outstanding improvement which came about as the end result of these various modifications, however, is this. Using a separate, small size receiving antenna, it is now possible to work break-in without other equipment of any kind. Another convenience is that we may now raise the gain to the limit without being assailed with a hiss like a steam locomotive letting off steam. Limiting the power of the bfo tends to limit strong signals to a point where they no longer prevent one from hearing DX stations. These latter come through much better, not having to compete with an overpowering beat frequency oscillator.

In conclusion we offer a word of advice to those who wish to profit by our experience. Should you decide to make any of these modifications to your present receiver, MAKE BUT ONE CHANGE AT ONE TIME. Then give your receiver a thorough test. This is because it is much easier to locate, and clear, one "goof" at a time than to find, and fix, many. Being human, we all make mistakes. The trick is to be able to profit by our mistakes.

Do not imagine that we have achieved the ultimate in noise reduction. This is only a small beginning. A whole unexplored field lies ahead for the researcher to delve into. We will continue experimenting and should further discoveries warrant publication, we will rush to the typewriter. . . . Gabus

The Improved Challenger

Some time ago a Viking Challenger was purchased by WA6BXZ. After a considerable period of time it was evident that the 6DQ6A's used in the final and driver were subject to instability and overheating. In fact, one plate cap of a 6DQ6A driver melted off! It was decided to replace the 6DQ6A's with 6146's.

The conversion is quite simple, and involves only shifting the base connections from the 6DQ6A's to those of 6146's. New plate caps had to be purchased, however, since the heat-dissipating caps for 6DQ6A's do not fit 6146's. The original parasitic suppressors were removed, since the heavy wire used could not be soldered to the new plate-caps, and new suppressors were wound, consisting of five turns of number 18 wire on 100 ohm two watt resistors.

Care should be taken to re-neutralize the driver and final stages after the conversion. If this is done properly the rig is a real improvement over the "stock" Challenger. There is plenty of grid drive on all bands, and the signal must be heard to be believed. The rig will load up to ratings and possibly higher.

. . . K6TBW

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The Mark IV

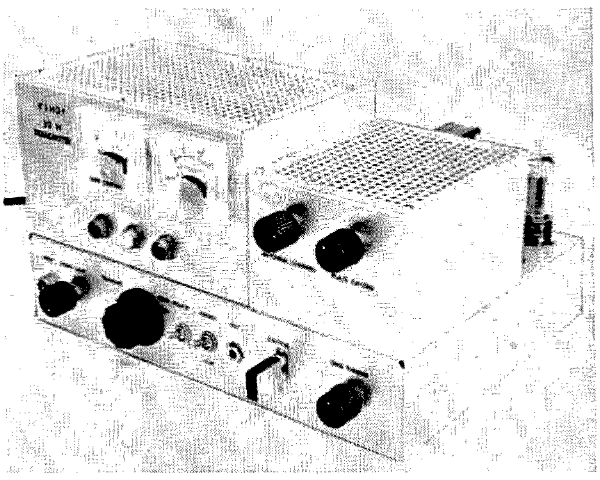
60 Watt Six Meter Transmitter

The transmitter shown in this article is the end result of some five years of on-again off-again spare time work. Using the same chassis, the author has rebuilt, added on and modified the rig so often that about all that is left of the original rig (2E26-10w) is the front panel controls. This final edition, the Mark IV, runs 60 watts input on 6 meters, fully plate modulated.

Circuit

The rf section of the rig consists of a 12BH7 harmonic oscillator-doubler feeding a 6146 run with about 500v on the plate. Eight megacycle crystals are used in the third overtone oscillator, the plate of which is tuned to 24mc by LI. The output of the oscillator then feeds a standard doubler stage tuned by CI and L2. Under loaded conditions a good 4.5ma of drive is available for the 6146. Detuning CI slightly will bring this down to the required 3.5 ma. The plate of the final is tuned by double spaced capacitor C2 and L4 and rf is coupled into the load by means of fixed link L5 and C3, a 100mmfd variable. The 10 ohm cathode resistor provides a small amount of self bias for the 6146. Both grid and plate meters are provided for the final. The two coils, L2 and L3, act as an rf transformer so that the doubler plate tank will "appear" to be in the grid circuit of the final, a condition necessary for neutralization. Were an rf choke substituted for L3 as is seen in some circuits, neutralization could not be achieved. Cn does the neutralizing.

The modulator design is straight forward and a close copy of one that appeared in the ARRL Mobile Manual.[1] That circuit would not supply sufficient power to fully modulate the 6146 at 60w input so I substituted a pair of 6L6-GC's for the 6L6's and upped the plate supply voltage to 450v. Lest some of you be aghast at applying such a high voltage to a pair of 6L6's

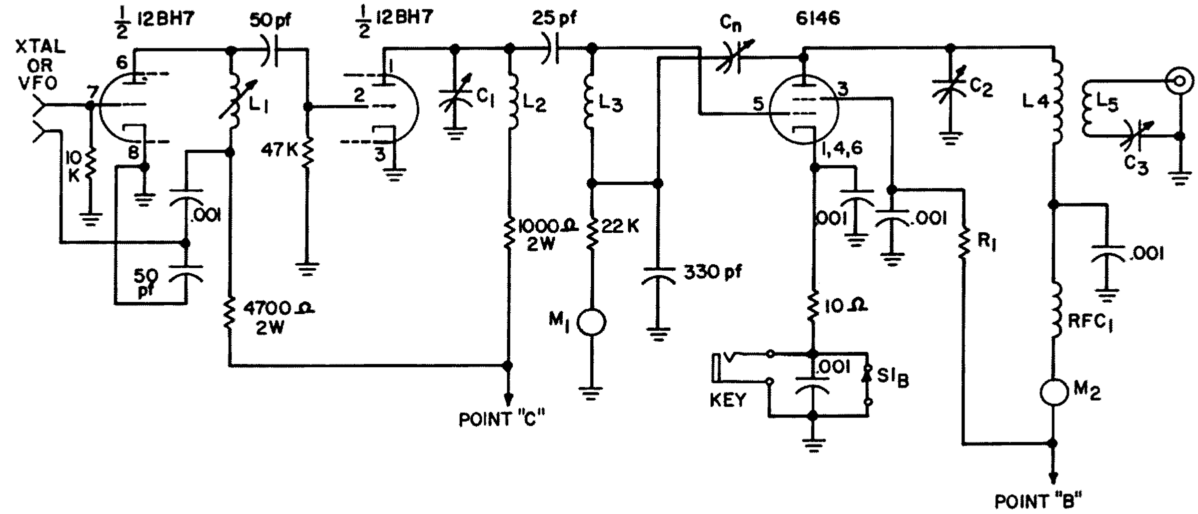


Front View: It should say 60 W on the panel, of course. The aduio section is to the left (in the box with the meters and pilot lights on it) and the rf section in the smaller box on the right. Covers for the two boxes are cut from a sheet of Reynolds Do It Yourself Aluminum. The control labeling should be self explanatory. The right hand meter reads plate current.

let me hasten to explain. These 6L6-GC's have a new form of plate construction which allows them to have better heat conduction and radiation than the old style plates, hence the higher allowable plate voltages. In fact, GE claims that a pair of 6L6-GC's, operated with 450v on the plates and 400v on the screens will give 70 watts output in AB1.[2] A 125 watt transmitter could easily be modulated by a pair of these tubes driven by a single 12AX7. In this rig, the pair easily overmodulates the final and care must be taken to prevent this. Some form of negative peak limiter would be nice but the author has not had a chance to try anything like this.

Power is obtained from a self contained

1 ARRL Mobile Manual, First Edition.
2 GE Ham News; Jan.-Feb., 1960.



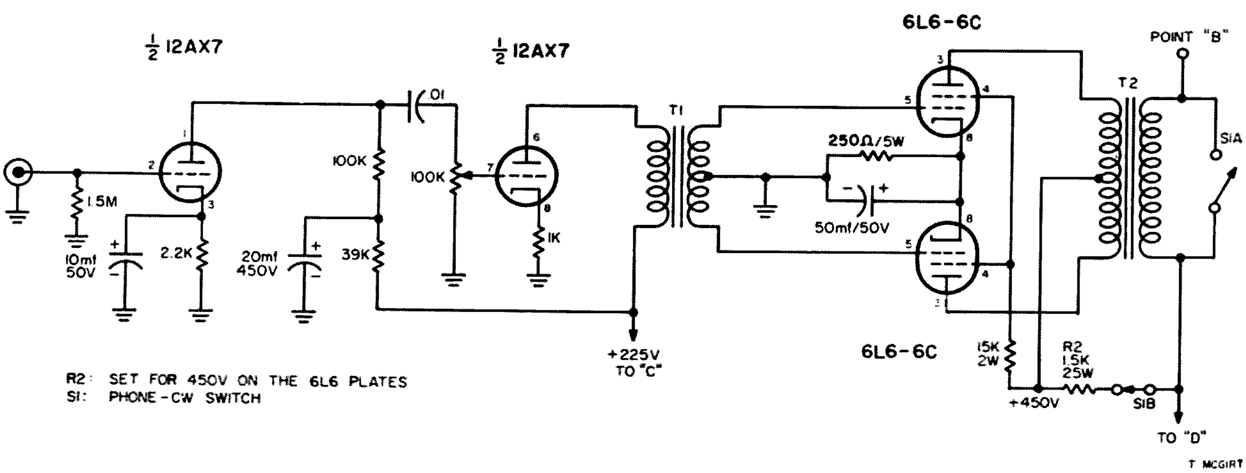
RF Section

"economy" type power supply using a 5U4-GB and a pair of 6DA4's in a bridge circuit. The power transformer (T3) was lifted from an old 16" television set as was CH2. Under load some 500v is obtained from the high voltage output and about 250 volts from the low voltage output. This low voltage output is used to feed the 12AX7 stages and operate the plate supply relay. Make sure that the transformer that you use is at least 375-0-375v on the high voltage winding. If it came from a large screen TV set the current ratings on the windings will be OK for this use.

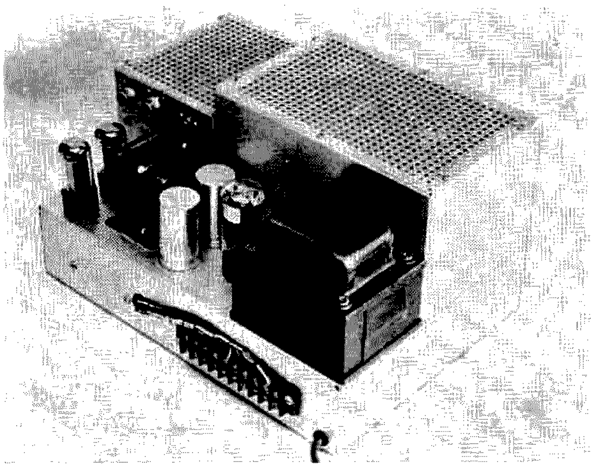
You could easily omit the plate supply relay mentioned above, but I feel that it provides more positive control over switching than the rotary switch originally used which arced over badly a number of times. The relay contacts K1a and K1b have .01mfd capacitors across them for spark suppression. As the control circuit is set up now, the rotary switch (S2) controls the pilot lights, activates the control relay and provides three spare sets of contacts (SPDT) which are brought out to a Jones terminal strip on the rear of the chassis. These extra contacts may be used to control an antenna relay, disable receiver B-plus, etc. The relay is mounted on a small "L" bracket near the 6DA4 sockets. You are not limited to this control circuit, of course. If you wish you may buy one relay with say a 6.3v ac coil, which will handle all the functions mentioned above and have push to talk. I like my method for fixed station use.

Construction

The entire transmitter fits nicely on to a 10"x14"x3" aluminum chassis with the audio and rf sections enclosed in small aluminum boxes for shielding purposes. A bottom plate is attached to the chassis for the same reason. The 5"x6"x9" box holds the audio section and mounts the meters and the 6"x5"x4" box houses the rf section. Shielding is complete in this



Audio and Modulator Section



Rear View: Eliminate the two can capacitors and mount the 6DA4's in their place. Choke CH2 can then be mounted in place of the 6DA4's. The leads to the barrier terminal strip are all "dead" and run to the TR switch for external control purposes.

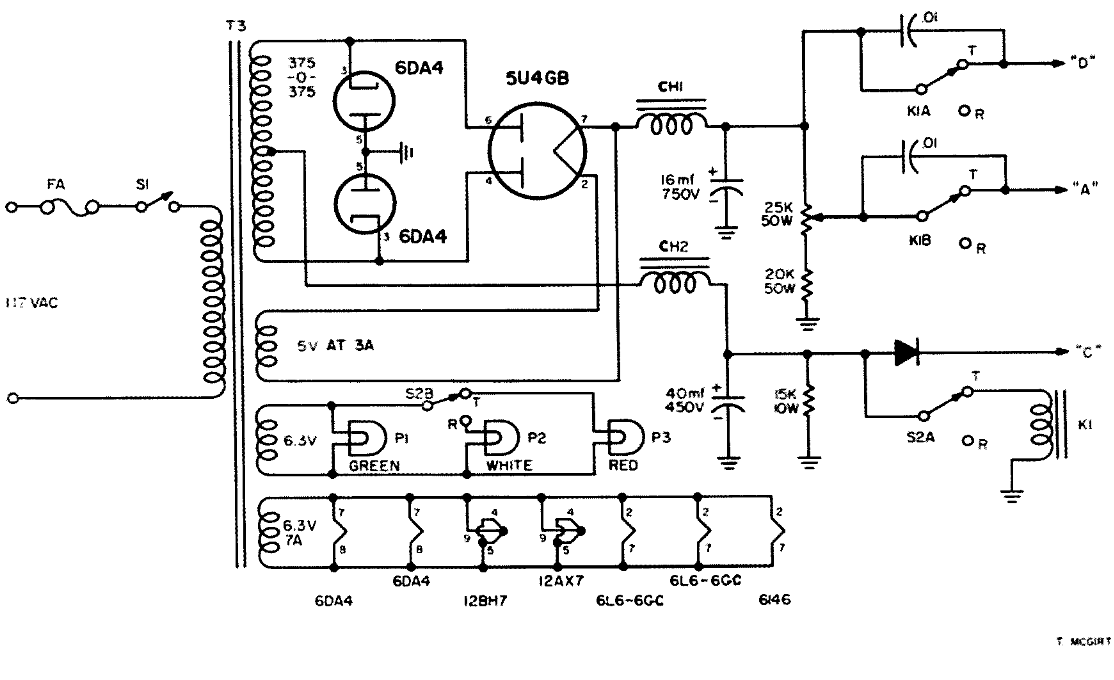
way and very little TVI has been experienced. Pieces cut from perforated aluminum sheeting are used as covers for the boxes to allow for good ventilation.

As you will notice from the photos, the chassis has a number of unused holes. This comes from all the rebuilding mentioned before. When you build the rig try to omit some of the more glaring things like that absurd hole the modulation transformer mounts in. I assure you, the rig will work just as well with a nice rectangular hole. Mount all of your large parts on the chassis after scribing lines on it to indicate the boundaries of the boxes (Don't forget to do this on the inside as well as the outside of the boxes to allow for the mounting flange).

I'd like to suggest a few changes in the parts layout born from experience with this prototype. Mount the two 6DA4's in the place of the two can capacitors (not shown in the schematic and not used). This will give you shorter leads and allow you to move the choke (shown beneath the chassis—CH2) to the place formally occupied by the 6DA4's. This will make the power supply wiring easier. Omit one coax connector and the RCA phono jack on the rf box and mount L1 slightly forward of, rather than slightly behind, the 12BH7. With the exception of the 25K-50 watt adjustable resistor, all other power supply bleeders and dropping resistors are mounted by their own stiff leads about where shown. All B-plus outputs of the supply are brought to a terminal strip near the center of the chassis.

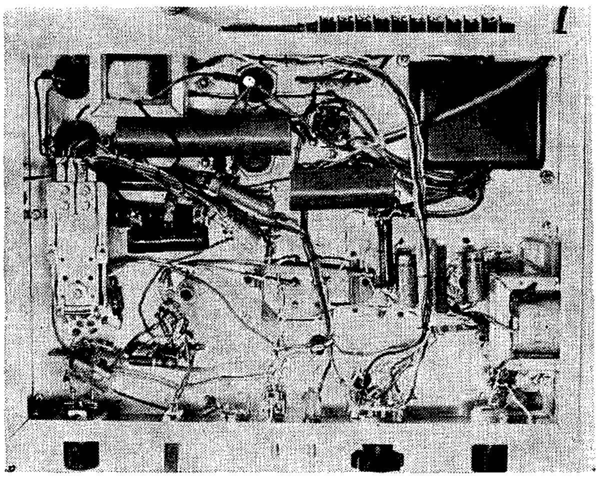
Wire up the rig, section by section, beginning with the power supply. Some 800v should be obtained under no-load conditions. Do the rf section next. As each section is completed it can be checked out separately—using a grid dipper and a 50 mc receiver. when the oscillator is running and stable, putting a finger on the crystal or near the plate tank should cause only a slight shift in frequency. Listen on a receiver at 50 or 24 mc with the bfo on. If the oscillator proves to be unstable, decrease the feedback by increasing the 50mmfd capacitor slightly. This should not be necessary since the circuit appears to be quite stable with respect to tube changes, etc. Keep your leads as short as possible and keep the rf leads away from the

POWER SUPPLY AND CONTROL CIRCUITS



T. MCGIRT

chassis. Filament and metering lines in the section are all run in small diameter shielded mike wire. The output link is constructed by slipping a 4" piece of non-plastic spaghetti over a piece of hookup wire and winding two full turns over the cold (B-plus) end of L4. Make sure the spaghetti you use will not melt. It gets warm in there. Twist the two leads to hold the link in place. You should be able to slide this coil up and down L4 about ¼" to adjust coupling. Resistor R1 is made up of two 100k, 2 watt and two 470k, 2 watt resistors all connected in parallel. When testing this section from the internal supply, series resistors will be needed in the B-plus leads to keep the voltages down. The 6146 should receive from 500 to 550 volts and the osc-doubler stage about 300v. Coils L2 and L3 must be spaced very closely because the drive is highly dependent upon the coupling between them. I got over 5 ma with the circuits peaked. Anything over 4 ma is sufficient. Neutralization is accomplished in the usual manner by removing B-plus from the final and adjusting Cn until the grid current shows no flicker as the plate tank is tuned through resonance. Under normal conditions, with 500v on the plate and 3.5 ma of drive, plate current will be 110 to 120 ma for 60



Bottom View: The audio driver transformer is mounted in the upper left hand corner just below the 12AX7 driver stage. Choke CH2 (lower right of the chassis) should be moved to the top of the chassis and L1 moved slightly forward to shorten its leads as suggested in the text. The neutralizing capacitor now resides on the terminal strip just below the grid tuning capacitor. The screen resistor of the 6146 (near the upper left hand corner of the relay) is now two 470K-1w and two 100K-2w resistors in parallel. The filter capacitors are mounted by their own leads as shown and the decoupling capacitor for the audio stages is placed below the audio driver transformer.

watts input. Without drive the current rises to well over 150 ma. The audio section is wired next and no special precautions are necessary. It would be a good idea to wire the 12AX7 socket before the driver transformer is mounted though. The phone-CW switch is also wired in now and the entire unit tested. With 450v on the plates of the 6L6-GC's screen voltage is 400v and cathode voltage is 33v. 100% modulation occurs with the gain control half open when close talking the mike in a normal tone. Before putting the rig on the air you should put the output on a 'scope so that you will know at exactly what point overmodulation occurs with your mike and voice.

As you can see from the photos, I have made liberal use of surplus parts and components. Scavenge an old TV set for the power supply parts and go through whatever surplus houses you have available for the audio transformers and such. At the time of writing, the modulation transformer (I used a Collins 7R3, nominally 20 watt job) was available for two bucks, the driver for 97 cents and 6146's were going for about $1.80 in the New York Cortlandt Street area. These items represent the major cost of any transmitter and buying them surplus (and using TV set parts) will keep the cost of this rig way down. Inexpensive meters help too. You'll probably have to buy the 6L6-GC's new.

That just about covers it. I have had good success and pleasing reports using this rig on 6. Even into an indoor dipole it was rare not to have a comeback when I went on. It appears that even in this day and age 50 watts is quite a bit of power on this band. TVI has been practically nil on a color set whose antenna is only 15′ from the transmitting dipole. Give the rig a try, I think you'll like it. Oh yes, if you want to use a VFO with the rig, feed the 8 mc signal into the crystal oscillator between the grid and ground, not between the crystal socket pins.

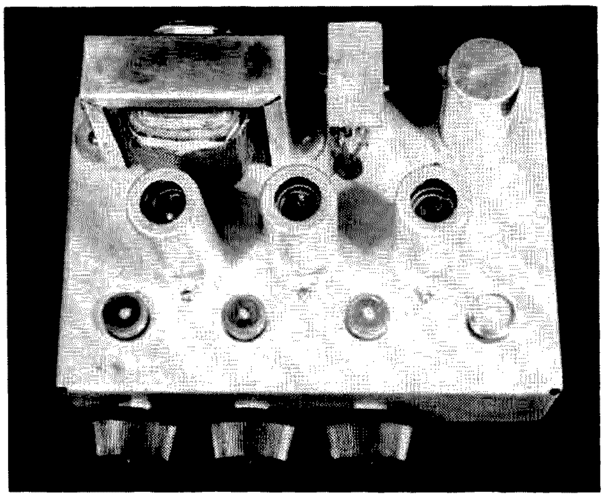
. . . K2HQY

PARTS LIST

In addition to the small parts shown on the three schematics the following items are required. Coil data is included

L1—16 turns #30 enam. on National XR-91 Coil Form (⅜" dia.-slug tuned)
L2—5¼ turns 16 TPI ⅝" dia. B&W #3007
L3—7 turns 16 TPI ⅝" dia. B&W #3007
L4—4½ turns 8 TPI ¾" dia. B&W #3010
L5—2 turns hookup wire tight wound on cold end of L4
C1—15 mmfd. miniature variable Hammerlund HF-15
C2—15 mmfd. miniature variable Double spaced HF-15X
C3—100 mmfd. miniature variable HF-100
Cn—Use standard 8 mmfd. variable with airgap sufficient to handle 1200 to 15,000 sudras E. F. Johnson 160-104 1.8 → 8.7 mmfd.
M1—0-5 ma. Shurite MT-317
M2—0-150 ma. Shurite MT-323
T1—Interstage Transformer Chicago Standard IN-16 or Equiv. Ratio pri; entire sec., 1:3
T2—#30 watt modulation transformer 1 :1 ratio. Surplus or use UTC S-19
S1—DPDT toggle switch
S2—6 pole, 2 position ceramic rotary switch. Centralab 2019
T3—TV Power transformer. Salvage from old TV set or use Stancor P-6315
CH2—Exact value unknown (removed from TV set). Can use hy at 75 ma
CH1—5 hy. 200 ma choke
K1—Hi-voltage Relay Coil resistance (dc) 10K. Requires 3 make contacts. 6.3v ac relay off filament line would work as well

Misc: Three ilot lamps, #47 bulbs, knobs, hardware, mike connector, tube sockets, plate cap for 6146, Jones barrier strip, terminal strips, Key jacks, 10x14x3 inch aluminum chassis, 5x6x9 aluminum cabinet, 4x5x6 inch aluminum cabinet XR-91 coil form



73

Parts Kit

Available

A Multi-channel Pre-amp

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807 Lincolnway
Valparaiso, Indiana

The pre-amp described here evolved as a result of having several transmitters on different frequencies, each with its own microphone or needing the microphone already tied to another transmitter. It was reasoned that with one pre-amp stage feeding several cathode-follower stages one microphone could be used on the operating table with each cathode-follower connected to a different transmitter. The low impedance of the cathode-follower would match the input of the two meter FM transmitter, this being one of the obsolete commercial two-way units, made obsolete by the FCC's so-called "split channel regulations." Most manufacturers of mobile two-way radios designed around the carbon

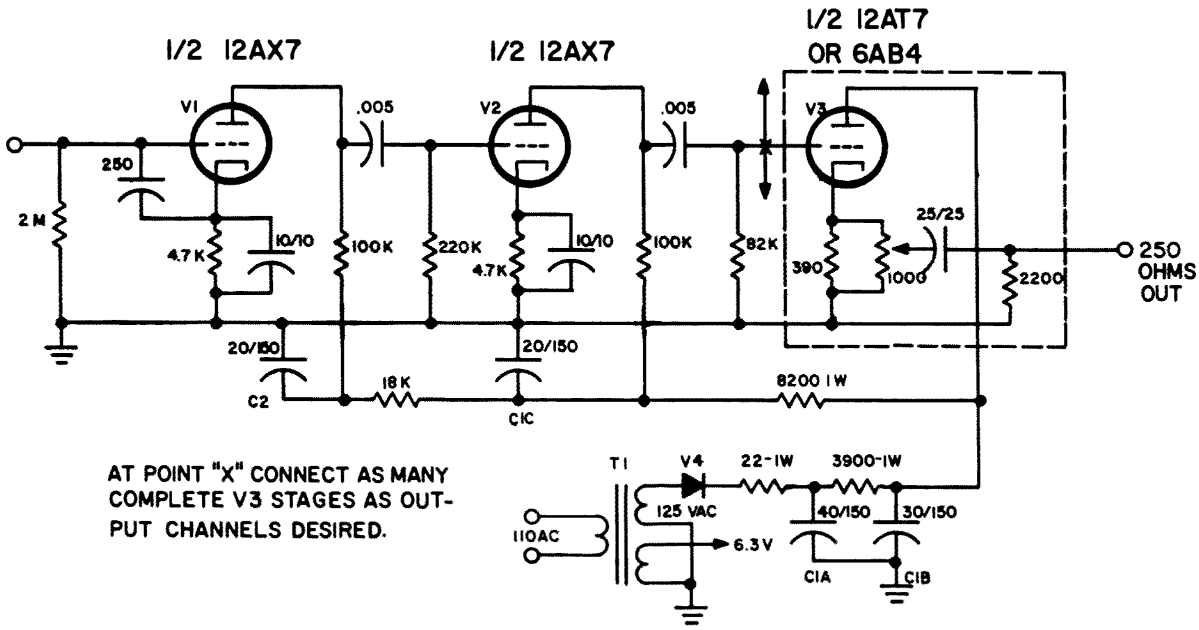
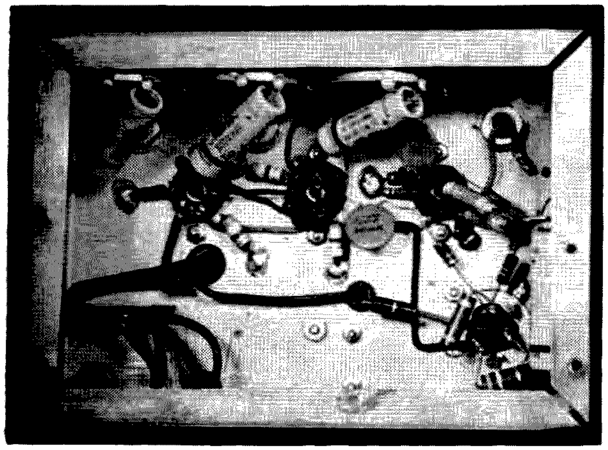


FIG I

microphone in the days prior to the transistorized dynamics now available. Also, the low impedance can be connected directly to the high impedance microphone inputs of most ham transmitters with a minimum of hum pickup problems. A word to the wise here. Use conventional shielded cables and wiring techniques when tying into any transmitter. Why ask for trouble?

The circuit and wiring of the unit is straightforward in all respects, as evidenced by the schematic and photos. The 12AX7 stages are used in conjunction with as many V3 stages as your particular application requires. The gain control in each V3 stage cathode permits adjusting the individual channel gains as required. Here, 1k pots were available so they were used in parallel with a 390 ohm to give the proper value of bias resistance. 250 ohm pots could be used if they must be purchased.



Interstage coupling was chosen to cause considerable low frequency rolloff. As shown in Fig. 2 the response is down approximately 18 dbm below the mid-frequency range. The mid-frequency output level is -8.5 dbm or approximately 0.3 volts. This level is more than adequate for transmitters previously using carbon microphones. Coupling capacitors could be changed from those shown if a different frequency response is desired. In my particular case, other operators objected to the excessive bass response in the original model. A standard input level of -50 dbm was used. Hum and noise measured 52 dbm below max output level. The transmitter audio characteristics are relied upon to give the necessary high frequency roll-off.

As noted in the schematic, no off-on switch was used. This unit is mounted under the operating table since after it is initially adjusted no further access to it is needed. It runs all the time that power is turned on to the operating table. Its very small power con-

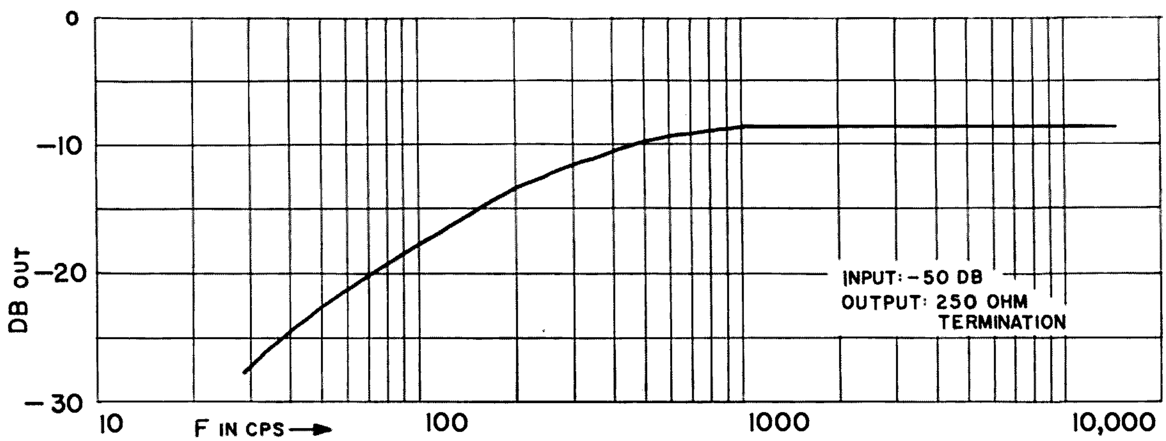


FIG. 2

sumption is negligible even if you happen to be operating CW.

The choice of power transformer, T1, will depend on how many output channels are required. Base this choice on the basis of 0.3 amps of filament for each 12AT7 or 0.15 amps of filament for each 6AB4. The 12AX7 also requires 0.3 amps. Select the transformer having adequate filament current rating.

. . . W9CWG

Parts List

All resistors are half-watt unless otherwise stated.
T1—Stancor PS-8415 or PA-8421. See text for selecting proper transformer.
V4—50 ma selenium or silicon diode
C1—40-30-20 ufd, 150 volt electrolytic
All other parts should be self explanatory.

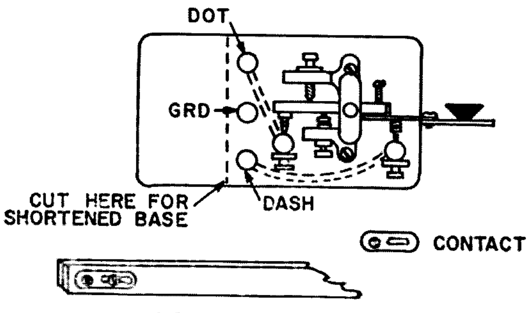
Modifications of Vibroplex Bugs

The easiest to modify for the "Do It Yourselfer" is the type of "Bug" using the solid-cast pivot housing.

The following ten step by step method is easy to accomplish with simple tools:

(1) Remove spring and vibrating arm from armature by filing the heads off of the two rivets and forcing out with a punch.

(2) Buy or fabricate a contact similar to the one used for the moveable dash contact (an old antenna relay contact is fine).



MOUNTING THE MOVABLE DOT CONTACT ON ARMATURE.

(3) Drill and tap the armature for 6-32 screw so that the contact will be as close as possible to the end of the armature on the left rear side.

(4) Cut the left hand arm of the pivot housing frame between the dot stop and the tension spring. This makes clearance for the repositioning of the stationary dot contact.

(5) Drill holes for the new stationary dot contact and for the grounded (base) binding post. (See diagram).

(6) Cut stationary dot contact support post to match the height of the dot contact on armature, mount in position with insulated sleeve and washers. Connect to insulated binding post on right side of base with short brass connecting strip under base.

(7) Mount insulated binding post in previ-

ous stationary dot contact hole. Use long connecting strip from dash contact after shaping it to clear new dot contact mounting screw.

(8) Mount uninsulated binding post between insulated dot and dash bp. Clean top and bottom of base down to bare metal and use star lockwasher for good electrical contact.

(9) If desired cut base behind binding posts and re-mount rear rubber foot.

(10) Total cost: 1 contact $.25, one binding post $.25.

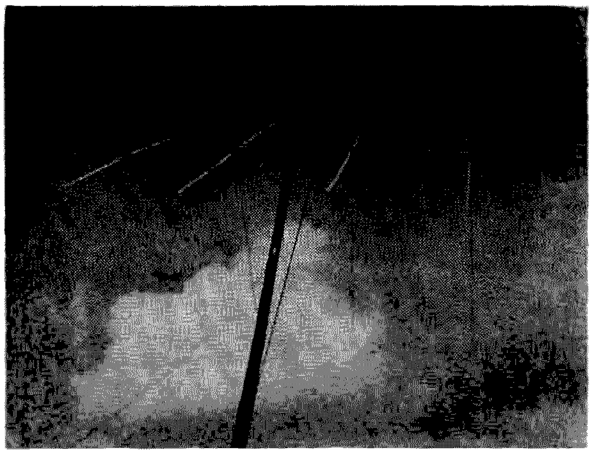
. . . W2CDJ

more use for the Knockout Punch

Many users of screw actuated, knockout punches may not be aware of their utility in cutting plastic and fiber material. Such punches are widely used for metal chassis work but their use often stops there.

Some insulation material, such as laminated Bakelite, is especially processed for superior punching characteristics. Printed circuit stock is a good example of this. Try a sample hole in a piece of scrap first. Some plastics, such as Lucite, will not punch without cracking while others will cut cleanly. Masonite hardboard, in both the ⅛" and ¼" thicknesses, cuts nicely.

Give it a try. The punches work well with most materials. One word of warning: Be careful with small pieces of thin work. If there is insufficient material around the hole, the beveled cutting edge of the punch may bend and crack the more brittle plastics. . . . W4WKM



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A Challenge to the Antenna Experimenter

This very controversial subject will be dealt with here, not so much from the technical angle but on practical operating results produced, the methods of achievement, mechanical structures and other odd bits of observations that may well be utilized by the quad experimenter.

Many years back questions arose as to "What is a quad?" "How does it operate?" Not having an antenna testing range nor other such technical equipment, I set out to learn as much as possible about quad operation under practical operating conditions. Results had to be obtained with equipment that could be found around most any ham shack and with the meager information found in other writings.

A small quad was built in the vicinity of 90 mc. This set up was about eight feet off ground and some surprising results were obtained. Two similar closed square loop elements were made, using .25 wave lengths per side, and spaced .2 wave lengths apart. A grid dip oscillator was coupled at the center of the bottom horizontal section. An FM tuner was set up several wave lengths away tuned to the resonant frequency of this driven element. The general method of tuning the reflector with a small stub was used by turning the reflector toward the FM receiving antenna and tuning for minimum signal. The usual results were obtained with a minimum backlobe and very sharp deep side nulls.

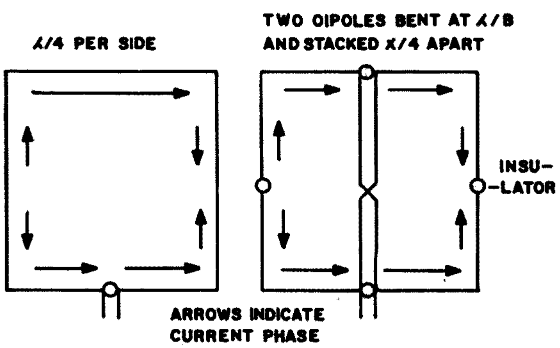


FIG I

Then, laying out the current distribution around the quad on paper, lead to the theory that two two-element yagis stacked one-quarter wave lengths apart and fed in phase should produce the same results. These two stacked yagis were found already available in the quad itself except the one-eighth wave length on each end of the top sections were bent down to meet the one-eighth wave ends of the bottom sections bent up, thereby voltage feeding the upper section in phase.

Insulators were then put in the center of each side of the quad on both reflector and driven element. (Fig. 1) Also, an insulator was placed in the center of the upper section. A transposed quarter wave open line was run from the feed point to the center of the upper section where the insulator had just been placed. This configuration gave the approximate results of the quad configuration but required more material and left no easy method of tuning the reflector or driven element. Sufficient power was supplied to the feed

point so that a neon bulb would light at the side ends of the driven element. As the bulb was moved up or down toward the center of the upper or lower section of the driven element, it would extinguish itself. An rf galvanometer confirmed the neon light conditions.

Because of the difficulty of tuning the director and reflector using this configuration, tests were made on the simple closed loop of the quad configuration with the same results thus showing that the high voltage points were on each side of the quad and the high current points at the center of the upper and lower elements. This experiment was to satisfy myself of a theory that had already been proven in previous antenna articles, and the satisfaction of knowing that the quad could be treated as a stacked yagi array.

Primitive methods? Yes, but still a beginning of practical application. Basically the quad is horizontally polarized unless fed at one side. The diamond configuration was not tried because it appeared from the current distribution that the side null would not be as complete. However, experiments by others have confirmed there is no difference in operation of the diamond configuration.

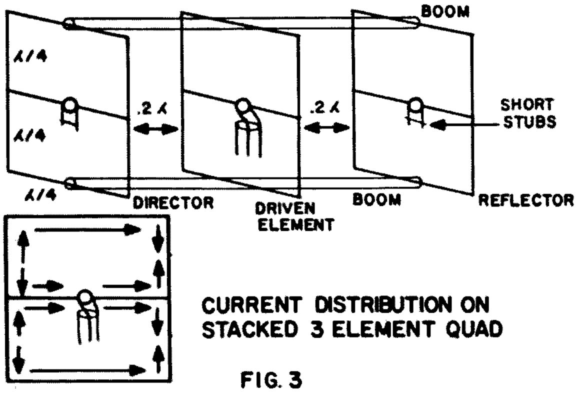


FIG. 3

Now came the time to try the full sized ham band models. The tri-band quad being in vogue with separate transmission lines used for the three different impedances for the three different bands didn't look good from this point of view. After several trys a simple spider and tri-band quad was designed (Fig. 2) so that all three bands would have the same percentage spacing. That is, .15 wave length on each band. This spider type of con-

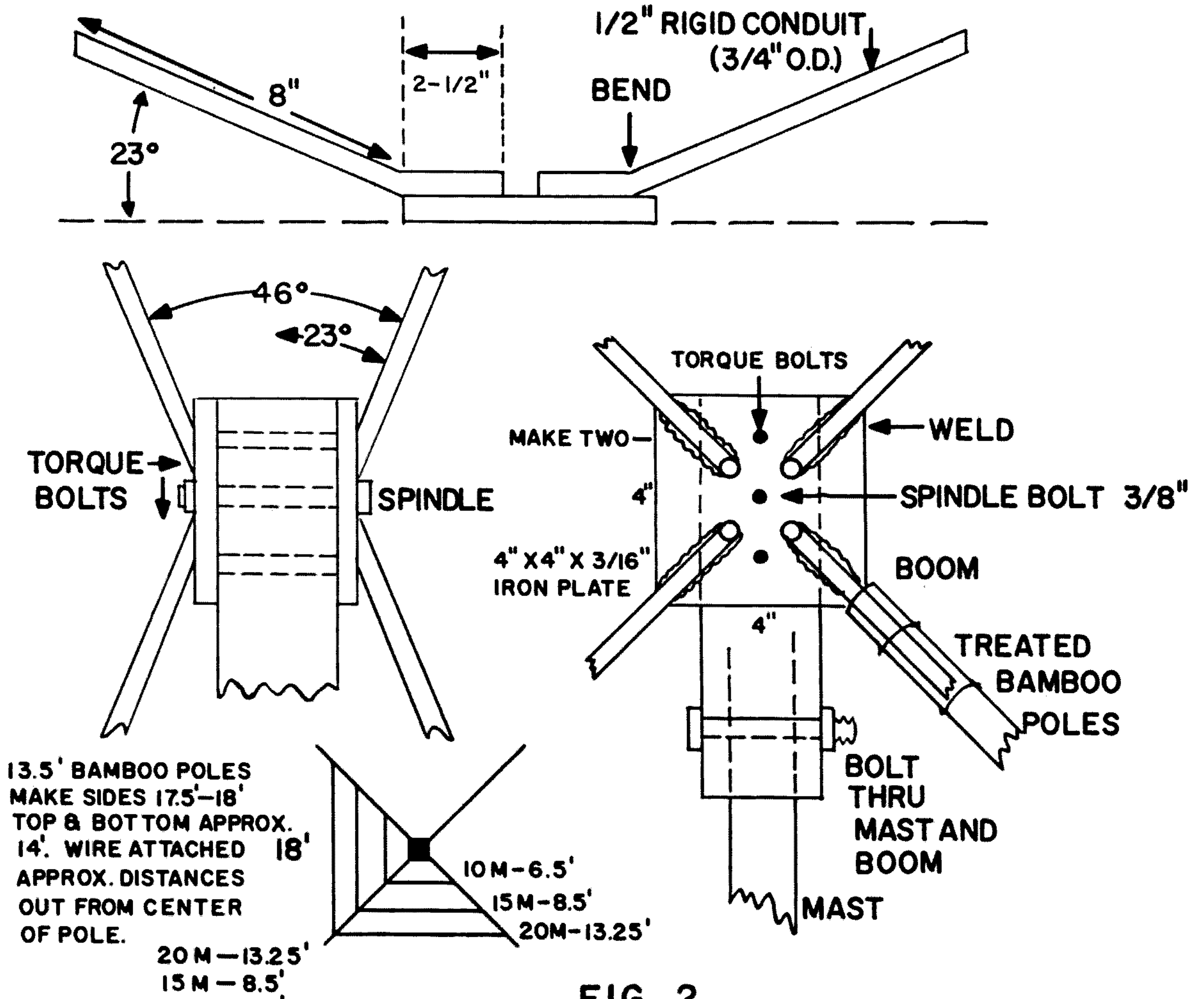


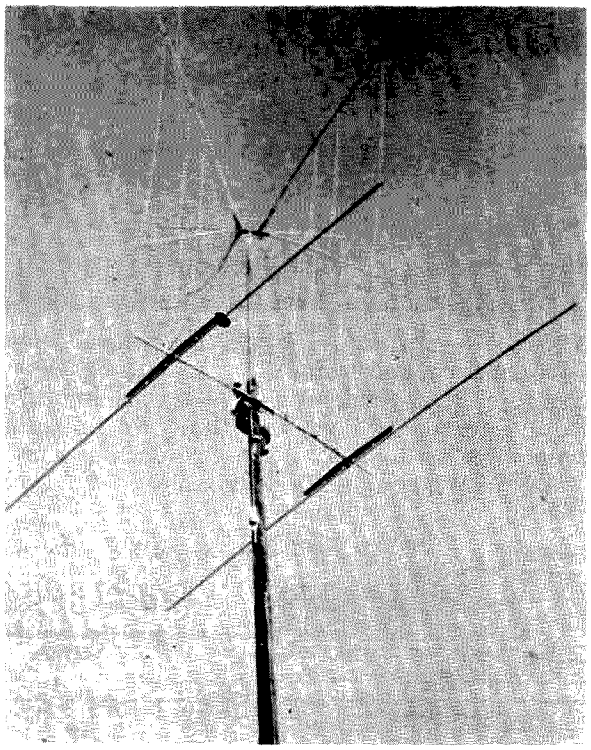
FIG. 2

struction at a heighth of twenty feet withstood 170 miles per hour winds during Hurricane Donna. Impedance measurements showed all three bands to be within a few ohms of 60, also that the spider angle design would allow additional quad elements up to 144 mc on the same spider.

The driven elements of the 10-15 and 20 meter bands were all paralleled at the feed point with no change of impedance because of the parallel arrangement. Measuring the driven elements, either singly or in parallel, the three bands showed very close to the same impedance.

A 52 ohm coax feed line was used and SWR measurements showed extremely broad banding on all three bands, ten meters going the highest of 1 to 3.7 at 30 mc at a design frequency of 28.7 mc.

Hours were spent with a fellow ham about four miles away to properly tune the reflector stubs on all bands. This, however, was not to be as critical an adjustment as at first thought. Of course, for maximum gain at a single frequency this adjustment would be critical. Depending upon the portion of the band for single frequency use, this could tune the reflector within the band thereby causing the driven and reflector elements to become both resonant at some other frequency making the beam become bi-directional. The method of tuning, explained later, eliminates this possibility with negligible loss in gain. This tri-band quad (actually five bands as six and two meter elements were added to the 10-15 and 20 with a single additional transmission line)



The "Box Kite." This took 175 mph winds down at 20 ft.

was operated for two years and compared against a manufactured medium spaced trap tribander with far better average DX reports from the quad.

On local station's signals little difference of strength was noticed. The quad would receive DX signals earlier and stay in longer than the comparison antenna. This observation may be due to the quad's automatic heighth adjustment of up to one-quarter wave between the lower and upper horizontal quad elements which possibly could be accomplished if it were possible to instantly lower or raise a yagi the same amount during skip changes.

Next, a three element quad was constructed on a twenty foot boom but was quickly discarded, only because a proper allowance could not be made for the driven element to swing around the 55 foot pole that was used for a tower. Initial tests, however, did prove promising, as this was used for a few months with a decided improvement in general overall signal strength over the long path.

Further development on the quad was temporarily interrupted for experiments with a stacked three element quad for FM reception. Our local broadcast station had been using an eight wave length per leg terminated rhombic antenna pointed to Miami for FM rebroadcast as part of the Florida hurricane network. It became necessary to pick up FM stations in more than the one direction. Fig. 3 shows a stacked three element quad which gave an excellent account of itself, not so much in gain over the rhombic, but in less fading, which is so prevalent on FM signals in this location. These FM quad results confirmed our faith in the theory and gain of a multi element quad.

Next, the commercially built tri-band three element yagi was raised again for further comparative tests. This time with its sixteen foot boom extended to twenty-six feet and two full size fourth elements added for fifteen and twenty meters. This was the first yagi beam used here that gave any indication of equalling or out performing the two element quad tribander and seemed as though it might be the ultimate for this location as a heighth of 55 feet is the maximum that can be used here. Wonderful results were obtained during the ARRL DX contest. However, with the "Long Johns" starting to increase in number around the States on towers with heights up to 140 feet, it became necessary to start something new. A five element yagi or a four element quad? The quad was chosen for further tests to maintain a "big signal." The four elements of the quad would mount properly, perfectly and very simply on a thirty foot boom and no difficulty would be encountered in turning the elements around the pole. The ten foot spacing between

Construction of spiders, four element quad.

elements gave plenty of clearance.

Fig. 4 shows the simple mechanical construction. The problem: How do you go about tuning the four element quad? Previous experience had proven one point; the closed quad loop as director or reflector was not as critical in tuning as was first supposed. Over a period of time a formula has been derived for element lengths that had met with all other previous requirements. These are somewhat longer than other published lengths to allow plenty to *cut off* rather than to *add on*. Stub lengths are never left more than approximately eight inches long. After initial resonating, should a longer stub be left, take out this portion of the stub by adding the excess stub wire to the perimeter of the square.

The driven element is equal to 996/FMC. Reflector is equal to 1,044/FMC. Director was equal to 946/FMC.

Electricians' "bugs" are used to hold the stub connectors and any other connections, then sprayed with Krylon to prevent corrosion. With no transmission line connected, but with the loop closed, the driven element is grid dipped to about 50 kc lower in frequency than the desired design frequency. The reflector is grid dipped to outside the low end of 20 meters to approximately 13.5 to 13.8 mc. The first director was grid dipped to outside the high end of 20 meters to approximately 14.4 mc and the second director resonated to approximately 14.4 to 14.45 mc. Resonating the parasitic elements outside the band prevents any possibility of the beam becoming bi-directional with little loss of forward gain and F/B ratio.

These adjustments were made with the boom about 20 feet off the ground. The lower sections were easily reached on a step ladder. Making adjustments at this low height requires resonating the elements approximately 50 kc lower than the design frequency as when raised to operating heighth (40-60 feet), the resonant frequency is raised about 50 kc or more.

The impedance measured about 38 ohms, a little low for 52 ohms,—but read on—when raised to 55 feet the SWR was almost flat from 14.0 to 14.350 mc!

This broad banding effect on the SWR was obtained with a beam impedance some 25% or more lower than the feed line impedance. Note that the SWR does not fall to unity at any given frequency, but that there is a general overall broad banding which proves much better than the unity at center of band and 4 or 5 to 1 SWR at either end of the band. (See G4ZU article CQ November 1959 page 67.)

Tests on front to back ratio naturally would

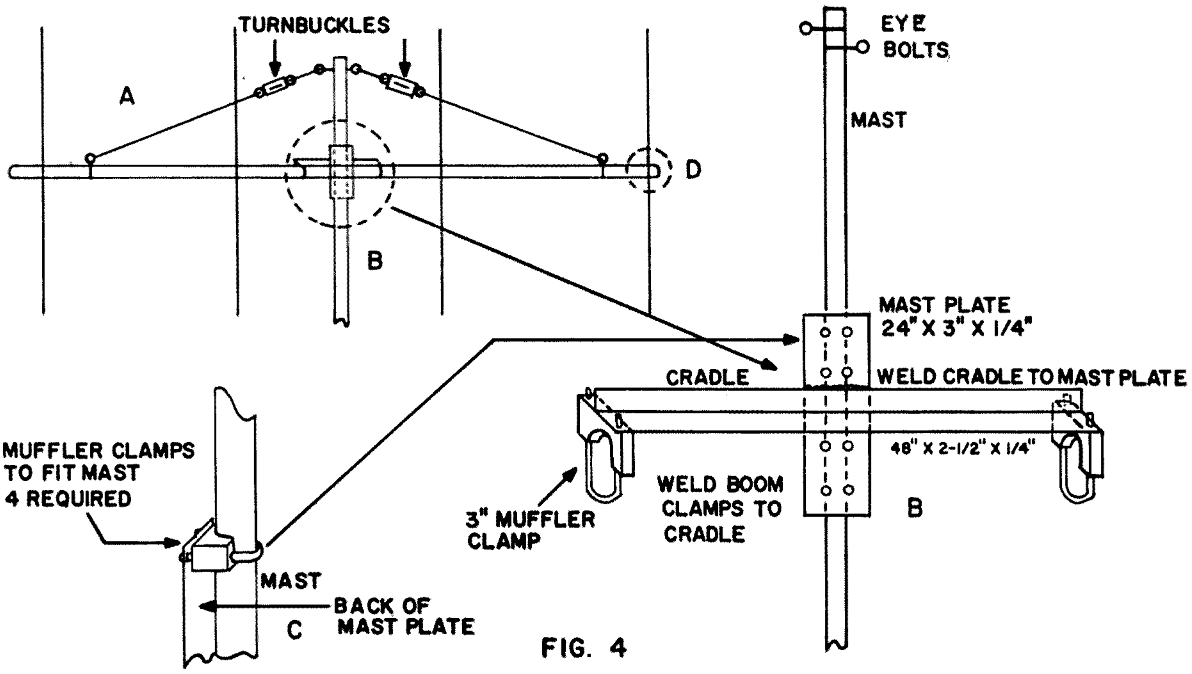


FIG. 4

be variable as with any beam antenna, depending upon the conditions at that time. Safely, the four element quad has 23 to 35 db front to back ratio. The forward gain showed 12 to 14 db over a dipole erected at the same height for test purposes. Of course, under some conditions of back scatter these figures are somewhat lower. The greatest gain is apparently on some lower vertical angle. Our tests methods did not include vertical angle measurements. However, a 2 S unit gain over a dipole is not to be sneezed at.

It is true that many yagi type beams show 10 db or more gain, but when it comes to getting a db or more, the average ham disregards this. "Well, it won't show up on the S meter." True, but has it ever been noticed that the "big signals" get to the Dx'er (who may not even have an S meter other than his own two ears) by a margin of only one-half of an S unit or less over the gang in a pile up? (3 db gain is enough for a noticeable change to the ear). How this apparent additional gain is achieved is not fully understood.

A further experiment with the four element quad was to operate two of the elements on 40 meters. The method used was stub switching.

The characteristics exhibited by transmission line segments as can be obtained from most any handbook, show that a half wave section of transmission line at a given frequency shorted at one end will exhibit the same impedance at the opposite end. That is zero or shorted regardless of the characteristic impedance of the transmission line. This property, coupled with the fact that a similar line one quarter wave length at a given frequency shorted at one end offers an infinite impedance at the opposite or shorted end. Thus, the same stub at 14,200 kc will offer a short opposite the shorted end, but at 7,100 kc will exhibit an infinite impedance or insulator opposite the shorted end. When this principle applied to

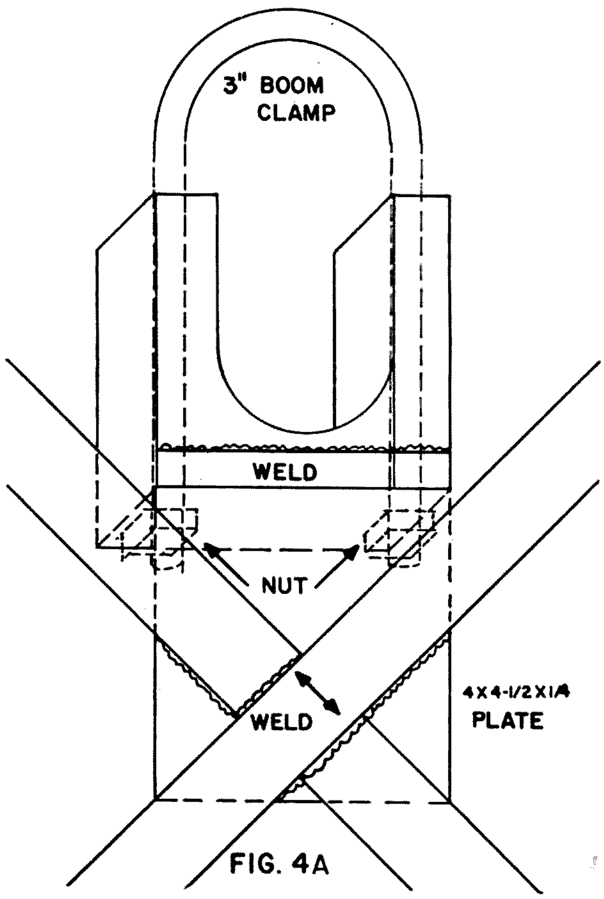


FIG. 4A

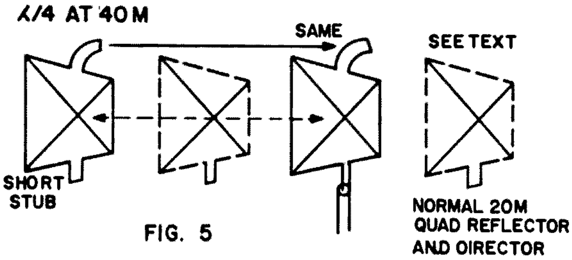


FIG. 5

two of the elements of the four element quad as shown in Fig. 5, it becomes possible to have a two element 40 meter parasitic beam with one-half wave elements folded in the shape of a square. These stubs had absolutely no affect on the 20 meter quad operation.

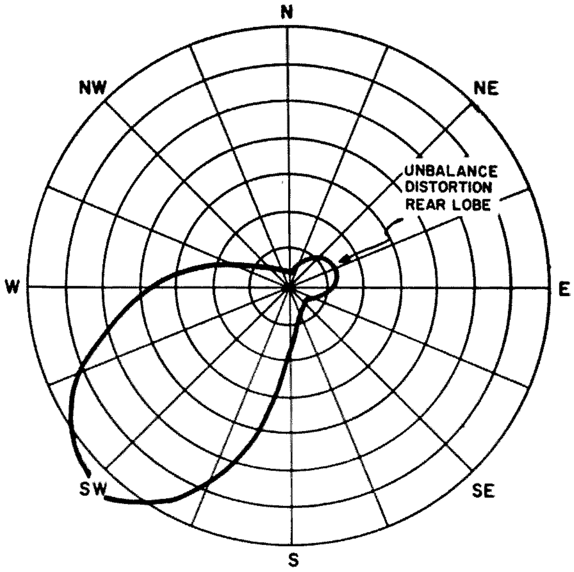
At this writing no further adjustments have yet been made to improve the operation of the 40 meter elements which do exhibit some directivity but with little front to back ratio.

Time has not permitted further experiments along this line but one wishing to have a four element 20 meter quad and a 40 meter beam antenna with the same transmission line and no relays or switches, this may be worth further investigation. Fig. 5 shows how the stubs are attached. It must be noted, however, that the word "beam" was used as it has been "sweatfully" learned that a so-called shortened quad with loading coils or stubs will take a load and show some directional properties, but with anything less than one quarter wave spacing between upper and lower and/or side to side wires the arrangement looses the quad characteristics.

Some readers may have noticed the unbalanced method of feeding the quad directly with the coaxial cable. Various horizontal pattern measurements have been made and in each, only the small rear lobe is partially distorted with no effect on the forward lobe. This was a very minor consequence from this point of view. Of course, a balun or gamma match could be used to rectify this situation and again one may refer to most any handbook.

Reversing the coax leads will, of course, reverse the slight distortion of the pattern on the rear lobe.

The final outcome of these quad experiments has been very gratifying. The signal from here has been greatly improved from

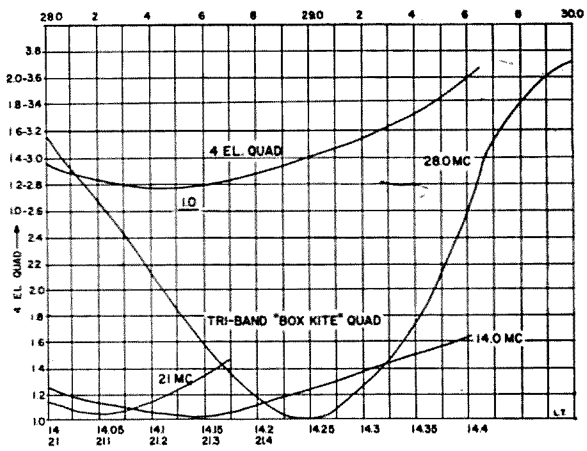


2 EL QUAD TRI-BAND 14.1 MC 40 FT

over the past few years and those with an experimental nature will find numerous new features in the antenna field within which to explore.

Experiments are now under way on a full sized dual band four element quad for 40; 20 and 15 meters. Gain figure for 15 meters should exceed 15 db and 8 db on 40 meters.

For invaluable help on tests over long and



short paths it is gratefully acknowledged of Reeve K4AW, Walt the late K5JLO in New Orleans, Jim VK6SA and Lambert ZS6IF. Locally to Armon K4FOM, Frank K4YPA, John K4UGE and others who graciously gave of time and energy. . . . W4AZK

LETTERS

Dear Wayne:

I would like to point out an error in the schematic of my article, "Building a 6 & 2 meter portable." (March, Page 33) The Ant. connector, switch S1-A, relay K1-A and K1-B, all are connected with coax, and the **shield** is grounded, not the center conductor as shown.

Also it should be noted that coil L1 is tapped 1/3 the way up from ground for the Ant. connection.

A very limited supply of the mmfd 27 mmfd variable, can be obtained by sending $1.59 to "Red" Johnson Electronics, 3311 Park Blvd., Palo Alto, Calif.

. . . Richard Juengel K8KDX16

PHL Revisited

Gentlemen:

I would like to comment on Fred Doughty's article "Double Sideband" in the Feb. '63 issue. I have long been a supporter and booster of DSB and concur with Fred's excellent comparison of modulation systems. However, to be fair about things, I think it should be pointed out that these comparisons are only valid when the final stage is coupled directly to the antenna. When, as is customary, the signal generated is amplified by a linear amplifier many of the advantages described are lost. This is particularly true of power in for power out comparisons. It is significant that even with the "linear equalizer" in the system we still have two sidebands for the receiver to select with DSB. Further, one point that seems to have been overlooked is the ease of bandswitching with DSB as compared to SSB. How about some expert coming up with plans for a good high power DSB transmitter with modulation applied at the final stage so that the "lazy linear" can be discarded?

W. E. English KØDLF/I1DFB

Dear Wayne,

In your capacity as editor of 73 how did the article by W3PHL in Feb. '63 on DSB ever get by your editing and appear in the Mag. It is the biggest bunch of garbage I have ever heard. It is untrue, contradictory all the way through and nothing but a bunch of doubletalk. Its proper place should have been for an April fool joke.

John Badali WA2VME

Att. Wayne Green Editor??

I have been a ham for 36 years and I have never seen any article published as stupid as the one you published by W3PHL. I will not spend any more money for your magazine.

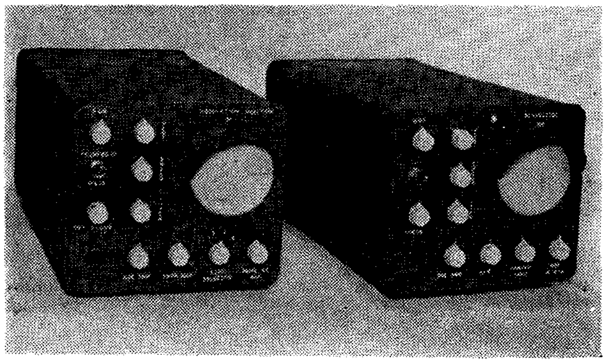
G. V. Lichtenfels W3AQT

Dear Wayne,

I enjoyed the thoroughly informative article by Fred Doughty W3PHL on the subject of double sideband.

Dick Genaille K4ZGM

F M FREQUENCIES
52.525 mc
146.94 mc



Denys Fredrickson WØBMW
3923 East Funston
Wichita 18, Kansas

Panoramic Spectrum Analyzer

HAVE YOU EVER wondered how congested the band was on either side of the frequency to which you were listening? Is there a hole in the QRM for one to which to QSY? Should one QSY up or down? How far should one QSY? When he did QSY, where did he go? How close am I to the edge of the band? How can one zero beat or check for splatter without changing the receiver dial? Does the received signal have carrier shift? These are but a few of the questions that can be answered by building this unique and easy to operate panadaptor. It is also a tremendous aid in chasing DX and for net operation.

The Panadaptor was designed and built as a twin to the Modulation Analyzer[1]. The same size chassis and case were used. The *if* and sweep circuits are similar to those in the "Snooper' built by W7HEA[2]. The components are all available commercially which eliminates reworking surplus gear which many times is difficult to obtain.

The signal input to the panadaptor is obtained from the first or second conversion stage in the receiver. Although connecting to the first stage will allow a greater bandwidth to be observed, the writer used the second stage because of convenience. A satisfactory bandwidth of 70 kc was obtained.

Circuit

The first consideration should be the signal from the receiver because the input of the panadaptor will have to match the frequency obtained from the receiver. The Panadaptor rf input transformers were stagger tuned to obtain the best linearity and bandwidth as possible.

The mixer-oscillator was tuned to a frequency of 630 kc so when mixed with the 455 kc signal from the receiver, the mixer-oscillator output frequency will be the panadapter *if* frequency of 175 kc. A different rf input and/or panadaptor *if* frequency may be used if desired by changing the transformers and/or retuning the mixer-oscillator to produce the desired *if* frequency.

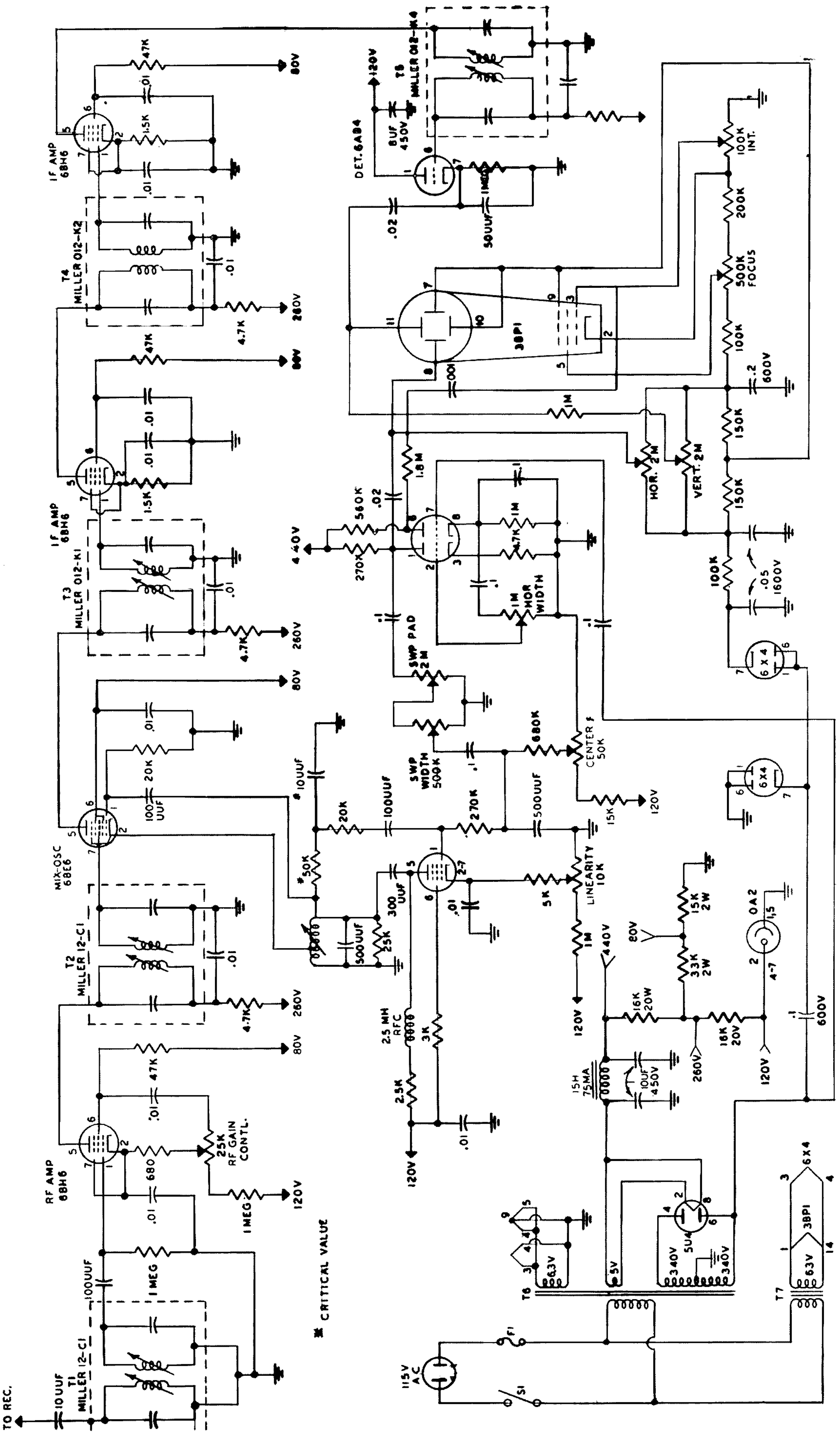
A 6AK5 reactance modulator is used to sweep the spectrum on each side of the center frequency by varying the reactance of the oscillator circuit which causes the oscillator frequency to change. The 50K resistor and 10 mmfd capacitor in the reactance modulator and oscillator circuit are somewhat critical for proper reactance tube and oscillator operation.

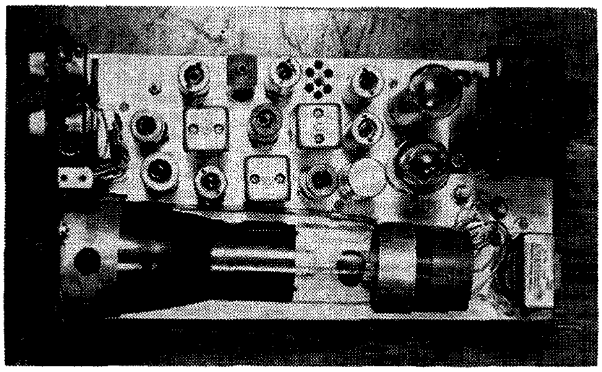
A question may arise concerning the 1 meg resistor which is connected between the rf gain control and B plus. This little device will allow a smoother and broader control of the gain rather than have it all bunched up on one end of the control.

The 12AX7 operates as a sawtooth generator and amplifier to drive the reactance modulator and horizontal sweep of the CRT.

The length of the base line can be adjusted with the horizontal width control. The sweep pad control (broad adjustment) and the sweep width control (fine adjustment) will control the amount of radio frequency spectrum that is to be viewed. By adjusting the sweep, the display can be varied until only one signal appears on the CRT. Centering the received signal on the base line is accomplished by the center frequency control. The

[1]Modulation Analyzer, CQ, January, 1961
[2]The Snooper, CQ, August, 1952


TO REC.
10UUF
T1
MILLER 12-C1
100UUF
1 MEG
RF AMP
6BH6
680
.01
47K
25K
RF GAIN
CONTL.
1 MEG
80V
120V
260V
T2
MILLER 12-C1
4.7K
MIX-OSC
6BE6
100
UUF
20K
T3
MILLER 012-K1
IF AMP
6BH6
1.5K
47K
T4
MILLER 012-K2
IF AMP
6BH6
T5
MILLER 012-K4
DET. 6AB4
8UF
450V
.02
50UUF
1MEG
3BP1
.001
1M
100K
INT.
200K
500K
FOCUS
.2
600V
150K
HOR. 2M
VERT. 2M
100K
.05
1600V
6X4
1.8M
560K
270K
4.40V
1M
4.7K
1M
HOR
WIDTH
SWP PAD
2M
SWP
WIDTH
500K
680K
CENTER
50K
15K
10UUF
20K
100UUF
270K
500UUF
50K
300
UUF
25K
500UUF
5K
LINEARITY
10K
1M
440V
2.5 MH
RFC
3K
2.5K
120V
.01
15K
2W
33K
2W
80V
OA2
16K
20W
16K
20V
260V
15H
75MA
10UF
450V
.1
600V
5U4
340V
6.3V
5V
T6
T7
3BP1
F1
S1
115V
AC
CRITICAL VALUE



linearity control interacts with the center frequency control and adjusts the linearity of the sweep of the local oscillator. The *if* amplifier and power supply are of the standard variety so time and space will not be consumed in outlining their function. The CRT controls are similar to those used on the Modulation Analyzer.

Construction

The receiver was modified by adding a 10 mmfd condenser or less to the plate of the stage you desire to use. Connect one end of the condenser to the plate and the other end to the center conductor of a short piece of RG-58/u coax. The shield of the coax should be left floating or above ground at the condenser end. Install a phono plug on the receiver and attach the other end of the coax to the phono plug and ground the shield at the plug end. The alignment of the receiver is generally not affected if the coupling condenser is small. This completes the receiver modification.

The power transformer should be positioned as far from the CRT as possible to reduce the affects of electromagnetic interference. In some cases it may be necessary to rotate the transformer to further reduce the interference.

The layout of parts is rather critical due to the limited space available, so care should be taken before holes are drilled. Use plenty of terminal strips under the chassis to facilitate wiring. The controls on the panel were located similarly to the controls on the Modulation Analyzer and will allow full control of the display. A temperature compensated condenser should be used for the mixer-oscillator circuit. This will reduce drift during warm-up and operation. However, there are controls on the front panel that will also compensate for drift. The case should be well perforated for adequate ventilation.

It may be desired to build the Modulation Analyzer and Panoramic Spectrum Analyzer into one unit. This would make a very attractive and much talked about accessory.

Adjustment

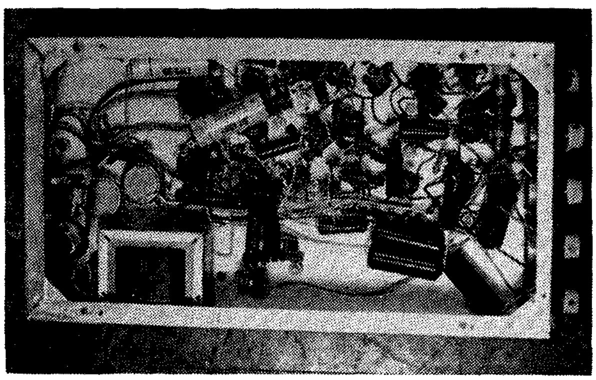
After the unit has been completed and wiring double checked, give it the smoke test by applying power. The filaments and pilot light should illuminate. Allow several minutes for warm-up before alignment. Remove the rf amplifier and reactance modulator tubes and connect a signal generator to the grid of the mixer-oscillator. Set the generator frequency to the *if* frequency of the panadaptor. Connect a VTVM or scope across the detector load resistor and tune the *if* transformers for maximum output. Adjust the panel controls until the base line appears approximately 1/3 of the way up from the bottom of the CRT. Place the sweep, center frequency and linearity controls to approximately the mid-position. Replace the rf amplifier and resistance modulator tubes and connect the signal generator to the panadaptor input. Set the generator frequency to the input frequency of the panadaptor.

Now align the oscillator frequency until a pip shows on the center of the base line on the CRT. If the signal generator frequency is varied back and forth, the pip will also move back and forth across the CRT. The rf transformers can be stagger tuned to produce as linear an output when observed on the CRT as possible, while varying the generator frequency.

The oscillator frequency may be determined with a GDO or by the use of a receiver. Place a short antenna, from the receiver, near the coil and tune receiver and/or oscillator until the signal is heard. The oscillator can now be tuned to the desired frequency. The second or third harmonic may be used, if necessary, for receiver reception.

Operation

After the unit has been aligned, connect the coax jumper cable from the panadaptor to the receiver. With receiver turned on and then tuning across the bands, you will get an idea of the type of presentation to expect on the



CRT. You may desire to touch up the alignment as a final adjustment.

The height of the pip will double when the modulation is 100%. Carrier shift is indicated by a sidewise movement of the pip under modulation. Splatter is evident when smaller pips appear and disappear on either side of the received signal when modulated. Zero beating is simply accomplished by moving the pip from your VFO to coincide with the received signal. Out-of-band operation can be eliminated when using a crystal calibrator and the panadaptor. You can immediately see if your signal is "In or "Out" of the band by its position with respect to the crystal calibrator signal. After calling CQ you can see the signals replying (within limits) without touching your receiver. The face of the CRT can be calibrated by using an overlay or thin strips of tape as markers.

The signal may be monitored by using a pair of headphones and by adjusting the center frequency or receiver the desired signal can be heard.

It is also a considerable aid for SSB and CW operation. It is the writer's opinion that it could be used in copying code visually for those that are deaf.

When chasing DX, the signals are sometimes quite weak. As you are tuning across the band you will see the signal before you hear it, thereby tuning more carefully when you approach his frequency. If the DX signal should take a dip at the time you tuned to his frequency, chances are you would have missed a rare one without the panadaptor.

The writer has worked 125 countries on phone in approximately two years and quite a few of these are attributed to the use of the panadaptor. It is a very versatile piece of equipment and will also enhance the beauty of the shack.

The writer wishes to thank Mr. Dick Azim, KφJEJ, for the fine job of photographing the equipment. . . . WφBMW

We'll pay $1 each for ideas good enough to print.

I'd like to see . . .

. . . coaxial cable made lower loss by silver plating the surface of the inner conductor since most of the skin effect loss is on this surface. Tinning increases skin effect losses, silver reduces it. . . . W2WLR

(W2NSD/1 from page 6)

S-920

The portents are good for the reciprocal licensing bill this time. Senator Goldwater fought it through all of the various agencies involved last year and was able to reword the bill so that all of the objections raised were taken care of. No great problems are envisioned in getting it through this year. The following are the reasons why I believe it important for us to give this bill all the backing we can. You may keep in mind that I am a well known worry-wart, though I alibi this deficiency in my makeup by pointing out that I haven't been wrong yet.

Passage of the bill will, I believe:

1) Permit us to operate from a great many countries of the world while traveling. This would allow us to do a lot more DXpeditioning and would also make it possible for us to meet the local amateurs through on-the-air contacts and achieve better people-to-people relations.

2) Foreign amateurs visiting the U. S. would be able to meet the lower powered U.S. amateurs and get to know them better.

3) The expense of visiting the U. S. is high and unfortunately it is the important and influential foreign amateurs who suffer from not being able to operate while in our country. We will have quite an advantage if we make this demonstration of international good will toward foreign amateurs. This will come home to roost at the next Geneva Conference when reallocations of the short waves will be the major matter of moment.

In this day and age of inexpensive tours and miniature transceivers we can benefit much from the passage of this bill.

Continental QSL Club Kaput

It seemed to me that the chain-letter economics of the Continental QSL Club would eventually be their downfall . . . well I was wrong. Section 25 of the Postal Regulations did it instead. You see, the Post Office has been set up as a monopoly by law so that there cannot possibly be any competition to their service. This possibly has a lot to do with the shape the P.O. is in now. The part that

(more trivia on page 85)

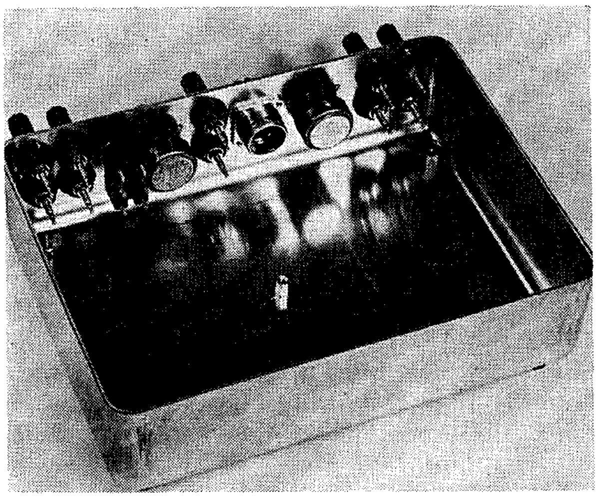
Shielding the Breadboard

Charles Miller W1ISI
General Radio Company
West Concord, Mass.

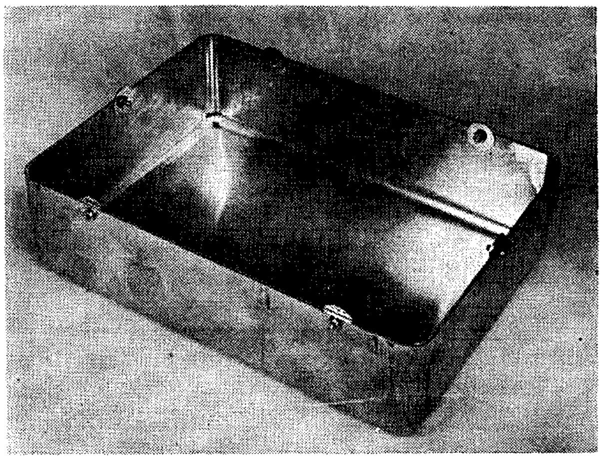
It appears that few circuits ever become successful without passing through what is known as the breadboard stage. The importance of this stage of development is not to be minimized, and some knowing individuals have even formulated laws for the construction of breadboards.[1] A number of materials have become available in recent years which are designed expressly for use in breadboard construction. One of the most useful of these has been perforated, insulated board. Most manufacturers supplying this material also supply complementary components specifically designed for breadboard work. Unfortunately, the need often arises to shield circuits from stray fields present either in the work area or between various parts of the circuit. The photographs illustrate my solution to this problem.

Basically, the breadboard should be a time saver. That is, it should allow the desired circuit to be constructed with the least possible attention to mechanical details. To avoid making odd packages for each new breadboard, the author built several standard packages. Each package has a variety of connectors and miscellaneous holes in at least one side. A section of standard perforated board may then be mounted on spacers permanently attached to the bottom. Breadboard construction then proceeds normally. A lid is provided for shielding purposes. When shielding is required between several circuits, they are simply mounted in separate enclosures and connected by means of shielded cables. Although the author's primary use is with transistor circuits, the total height is sufficient for vacuum-tube work, though ventilation should be provided.

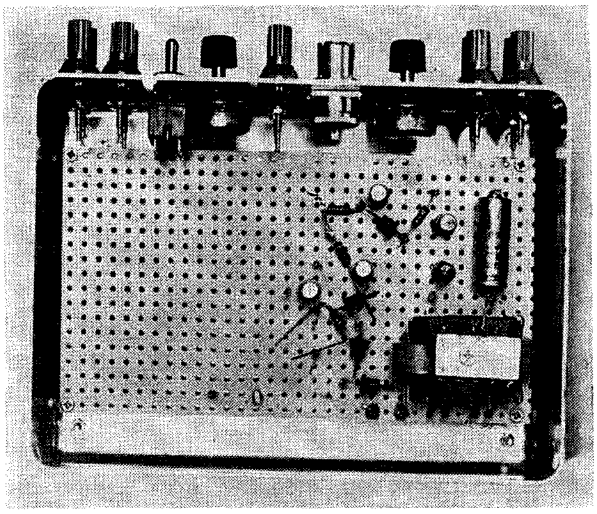
The enclosures shown are deep-drawn aluminum boxes manufactured by the Zero Manufacturing Company.[2] Although standard, less expensive electronic chassis or boxes could have been used, the absence of the lip is highly desirable. The enclosure and its lid are identical, measuring 6⅝ by 9⅛ inches, 2½ inches deep. This leaves sufficient clearance behind permanently mounted components such as connectors and switches, so that a section of Vector-board® may be readily inserted or removed. The choice of connectors, of course, is up to the individual, but it is recommended



Shielded breadboard cabinet illustrating a variety of components and connectors mounted on one face.

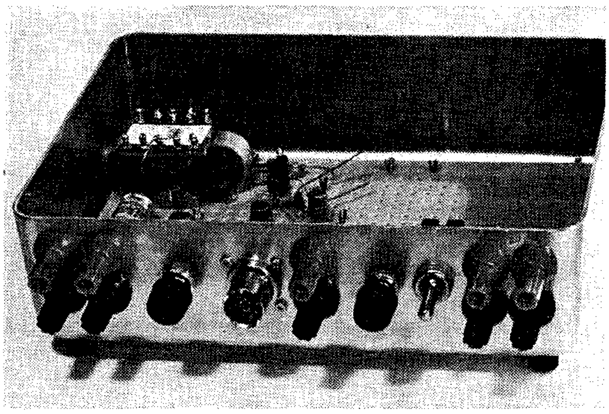


Cover is made by bolting washers to inside of box of same dimensions. Total height is adequate for vacuum-tube circuits (see text).



Top view showing perforated board in place. Note accessibility of terminals on panel-mounted components through the use of a deep-drawn box. Additional components may be mounted on rear face, if required.

that they be of high quality as they will undoubtedly remain permanently attached to the cabinet and receive a great deal of wear. As many as possible should be installed as they constitute the only electrical access to the circuit when the cover is in place. The binding-post type shown is extremely versatile and when properly spaced may be used with commercially available banana plugs and shielded cables. Good coaxial connectors should be provided for higher frequency use. Additional holes accommodate switches, potentiometers, etc. Five spacers have been provided, placed so that they line up with hole centers in the Vector-board. The fifth spacer (center) will be found necessary if it is intended to use the standard Vector push-in terminals. The added support eliminates the possibility of breaking the board or causing a short when inserting terminals. Rubber feet are provided to prevent marring bench tops by the heads of the screws holding the spacers down. Photos 2 and 3 illustrate some breadboard work in progress. The enclosure as shown was adequate for this particular circuit. Had this not been the case, additional components and/or connectors could have been mounted along the rear face of the enclosure without hampering the removal of the entire board.



Front view of cabinet with perforated board in place.

The integrity of the shielding will be maintained if snap buttons are employed whenever the components are permanently removed. Covers are made by simply bolting washers around the inside edge of identical cans as shown in Photo 4. If vacuum-tube work is anticipated, adequate ventilation must be provided. Screen-type snap buttons may be used on the sides of the main cabinet and the top of the cover. . . . W1ISI

[1] Johnson, R. W., The Art of Tacking, Electronic Design, July 19, 1961, p. 176.
[2] Zero Manufacturing Company, 1121-23 Chestnut Street, Burbank, California.

A Broad Band, Coax, Folded Dipole

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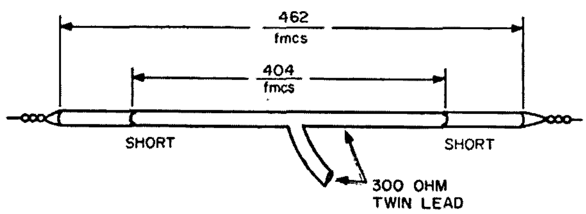
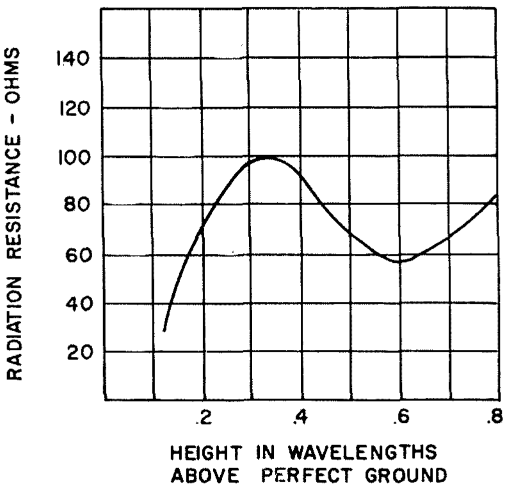
I have heard numerous comments on the bands lately such as, "Don't work any CW here on 80 meters because my antenna is tuned for the phone band and won't load up down there." "I can't talk to him because he works on 3810 and my antenna is cut for 3950." "I'm using an inverted V antenna and the apex angle is sharp causing the bandwidth to be narrow." "I want an antenna that will perform well with a low SWR across the whole 20 meter band." "I can't put up a low frequency dipole because I haven't got the room." This article is presented for these persons' benefit.

Many oldtimers who have used the folded dipole antenna will recall that shorting the two wires of the ribbon a distance out from the center equal to the velocity factor of the ribbon times a free space quarter wavelength, see Fig. 1, will cause the antenna to have a more constant impedance match over a wider range of frequencies thereby giving better bandwidth characteristics. This is the theory on which the material presented here is based with minor variations to suit one's need and fancy.

Since most new commercial transmitters have a relatively small variation in output impedance, 52 ohm coax is a natural choice for a transmission line. When connected to an ordinary wire dipole antenna, coax will match adequately over a relatively narrow range of frequencies provided the dipole is at the proper height





above good conducting ground, see Fig. 2, and effects from surrounding objects is held to a minimum (get it out of those trees and above the house roof). The antenna described here will perform over a comparatively wider range of frequencies than the conventional dipole.

Basically the antenna is a folded dipole made from coax cable. The flat top portion of the antenna is constructed of coax cable (of the same impedance as the feedline) with the end extensions made either of coax, copper wire or twinlead. The end extensions can be fanned or dropped, see Fig. 3, depending on how large your lot is. Fanning the ends (either horizontal or vertical) is desirable in that the Q of the antenna is lowered more by further decreasing the effective length to diameter ratio, hence the antenna bandwidth is increased. This type of construction is very effective on 80 meters especially if the fanned wires are coax cable. It must be kept in mind that fanning the ends of a dipole will shorten its resonant length. The factor depending upon the degree of fanning.

The total length of the shorted center portion which should be made with RG-8U coax (RG58 will work OK with decreased results) is;

$$L_T = \frac{492 \times .66}{f_{mcs}}$$

L_T = Length in feet of center part
f_{mcs} = Mean frequency of operation (megs.)
The length of the end extensions would then be;

$$L_E = \frac{231 - L_T}{2 \times f_{mcs}}$$

L_E = Length in feet of one end extension
f_{mcs} = Mean frequency of operation (megs.)

Hence the total length of "shorted" coax in the flat top portion for 80 meters would be 86.6 ft. and the length of each end extension would be 19.2 ft. making the overall length of the antenna 125 ft. At each end of the coax in the center of the flat top portion the braid is shorted to the center conductor by stripping the insulation, pushing the braid back, stripping the polyethylene and twisting the two conductors together. At this point the end extension wires can be twisted together with the "short" and the connection soldered. Make sure this connection is substantial both electrically and mechanically because these connections support

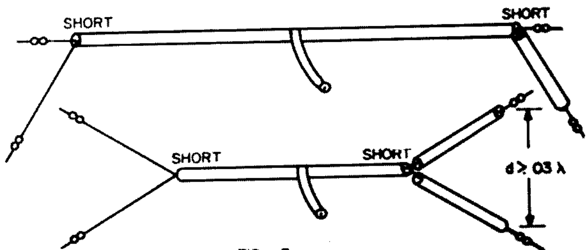
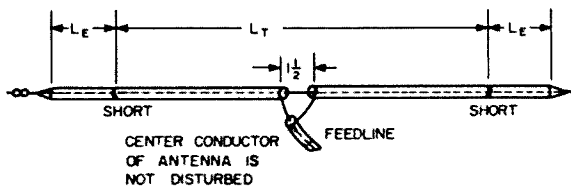


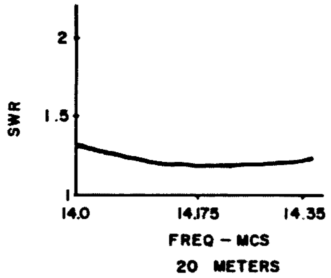
FIG. 3

the weight of the antenna. The feedline is fastened at the center by cutting the braid exactly at the center of the flat top portion without disturbing the center conductor and its insulation. The braid is then separated not more than 1½" and pigtailed so the feedline can be soldered to it, see Fig. 4. When soldering the feedline to the parted braid use long nose pliers to conduct heat away from the polyethylene to prevent excessive heat damage. The completed connection is then taped sufficiently to prevent



L_T - TOTAL LENGTH OR SHORTED PORTION
L_E - LENGTH OF EACH END EXTENTION

FIG. 4



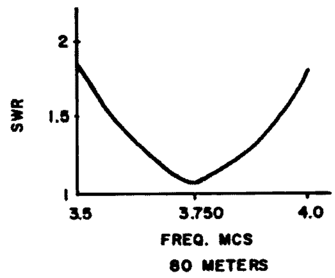


FIG. 5

water from entering the coax. (Note: this connection when made properly is sufficient to support the heavy coax feedline.)

Halyards can be fastened at the feedpoint and ends to raise the dipole and provide a means of adjustment of feedpoint impedance by adjusting the height of the antenna while observing the SWR at the design frequency. Since coax is heavy, end insulators with sufficient strength should be used to support the antenna. It is desirable to support the center of the antenna as high as possible and adjust the ends for lowest SWR at the design frequency. The reason for this is because most of the radiation takes place from the center part of the antenna. The antenna lends itself to be used as an inverted "V" very nicely with an increase in bandwidth over the usual wire inverted "V" which generally has a narrow bandwidth due to a sharp apex angle.

Two of the described antennas have been constructed at this QTH with results as presented, see Fig. 5. No gain or fantastic increase in signal strength is claimed with this antenna as it is still only a dipole but the improvement in operation at frequencies far from design resonance is advantageous and noticeable. This improvement could be considered as a gain. Many hams throughout Michigan, Indiana and Ohio are using this antenna on 75 meters with variations in construction as shown with similar results as presented.

Homebrew Exposed

W5HJV

We never cease to be amazed at the homebrew construction articles in the ham radio magazines. You know, the ones where the chassis doesn't have a single extra hole, and is all decked out with store boughten parts.

Down about the third paragraph, the author casually mentions that part number F-1 (Multi-Frammis Snickafoo Filter) can be special ordered from Shifting Sands Electronics Corporation for only $75. And of course old Charlie down at the machine shop was happy to make the gears for the dial drive for $25.

Needless to say, this is enough to make the average amateur return to stamp collecting. One must inevitably conclude that the amateur builder must be either a fabulously wealthy eccentric, or a bright young engineer with sticky fingers.

Fortunately, fellow amateurs, such is not the case . . . and in support of this statement the following parts list, complete with translation, is respectfully submitted.

Parts List	Translation
19" x 12" Chassis	Any size available. Check kitchen for suitable cake pans, etc.
350 mmfd variable (Raunchy Radio Co. Part. #QQ-4X4)	Tuning condenser removed from XYL's clock radio.
1 mfd 400V tubular	This is for the key-click filter, stupid . . . leave it out.
16 mfd 700V electrolytic	Any electrolytic in the junk box which will handle the voltage. Check possibility of using assorted sizes in series.
Inductor, 9½T. #20, 1" O.D., 4 T.P.I.	Any size wire wound around varnished toilet paper tube. Cut and try for resonance.
750 uh RFC) 2.5 mh RFC)	Two rf chokes from junk box . . . inductance unknown.
26,000 Ohm, 2W resistor	Any combination of junk box resistors which hits within 5000 Ohms.
50,000 Ohm, 4W potentiometer	Grid drive control removed from front panel of brother-in-law's rig.
Fused Line Plug	No fuse necessary. Use cord and plug from XYL's hair dryer.
900VCT 200 ma power xfmr	Cannibalized from stand by rig if within 300V either way.
8 Henry 300 ma filter choke	Secure from K5BNK's garage. Flashlight and sneakers are strongly recommended for this operation.

Getting into Electronics

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San Jose 8, California

The ads for courses in electronics read so rosy, it is misleading. The electronics course is an excellent thing to have, but is only the barest beginning towards a career in electronics. These courses only put you in a position to *begin* to learn how to actually *do* things. To get paid, you must be able to DO things. Experience as a ham is one of the best qualifications for an electronics technician career. The engineers are supposed to furnish most of the theory and the technicians are the practical workers that put the theory into practice. Many an enginner's lamp would be very dim without the backup of some sharp technicians.

Let's take a look in the Jennings Radio's Radio Frequency testing laboratory to see what technicians might be doing on a typical day.

"Tut" Tuttle, senior electronic technician in Jennings Radio's Radio Frequency laboratory arrived as usual at about seven thirty A.M. As foreman, he is not "on the clock." He is privileged to keep his own time. So, he arrives about thirty minutes early every day—no overtime either—and usually is fifteen minutes or more late getting away at the day's end. But there are few things that would worry him less than a few extra minutes of his time on the job.

Leonard Espinosa operating Jennings Rig No. 3, a 20 KW linear amplifier with a 4 W 20,000 in the final.

In the past half century or so, he has made a long string of tracks that has given him the wide experience that is so valuable on his present job. He has been on his present job for over 6 years. His previous job was as electrical maintenance foreman for Westinghouse during World War II. Before that was power house operator, and various other comparable jobs.

Most of his family are grown up now. Two have gone to college. He is active in community work.

Only in recent years has Tut gotten a ham ticket, though he has had the ham instincts all his life. Now he is as ardent a ham as any high school boy.

The brief few minutes before the gang arrive is about the only time till quitting time Tut will get to sit at his desk. He turns over a fresh page on the desk calendar and initials the work cards of his crew from the day before. He knows from experience that this must be done before eight or they will likely not be done by the time the girl from accounting comes for them.

As the rest of the crew arrives, Tut exchanges pleasantries with them, while considering the jobs to be worked on that day. The rest of the crew consists of technicians of various skills and levels of experience.

There is the usual load of rf testing to be done, plus some special tests. Tut discusses this with Bob Goddard, leadman.

Bob arrived with a ham ticket and a high school diploma some eight years earlier. Start-

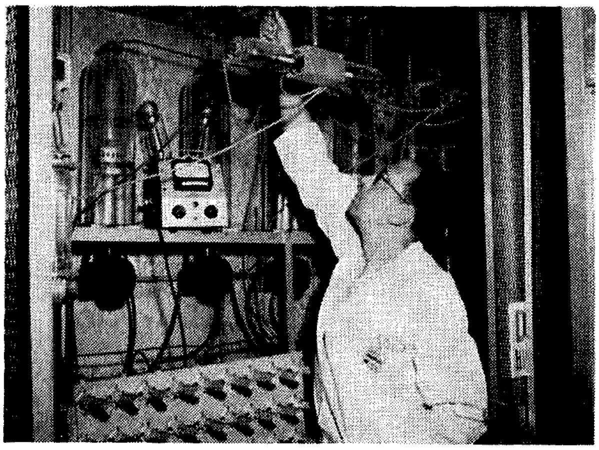
ing as a junior electronic technician, he worked up to leadman due to an excellent personality and a natural aptitude for getting things done. He was willing and able to accept responsibility and figured that if he worried about the work, the pay would take care of itself.

Like most of the technicians, Bob has set up an excellent ham station at his home, including SSB & Teletype. His other activities include bowling in the two-hundreds, and flying a Cessna 150.

Bob prepares for the day's testing by examining the test reports left on his desk by the night crew. He puts these in the basket to be filed later by the secretary. Now he checks that his various operators are assigned and have work before them. By the time he has made a couple of telephone calls regarding units to be tested, made out a consolidated report for the supervisor's attention, and helped re-tune one of the transmitters that was a little balky, the noon whistle is stopping all official activity. Actually, tho, the difference is small. Many of the tests are on a basis of time, and the operators are reluctant to interrupt them, so they pull out their "sacks" and eat while watching the test.

Bob has four test operators helping him with his regular testing, plus four more on special tests. His equipment includes a 50 by 150 foot building full of rigs from a few kilowatts to a hundred KW. There are rf generators to test switches, capacitors, insulators, etc. Most of the rigs are linear amplifiers for ease of controlling the output and low harmonics. The operators have all been trained on the job, usually arriving with a ham ticket as their main credential. Besides operating, they often maintain the equipment when needed.

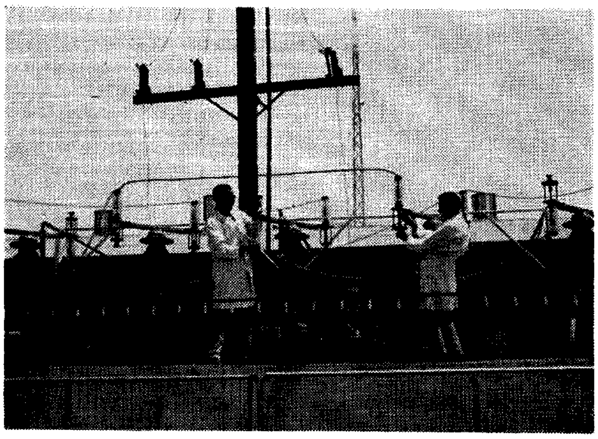
Lloyd, the senior operator of the test crew, has had a ham ticket for 34 years. He proudly boasts 11 grandchildren. Very soon he will be great grandpa. Now he takes his test request sheet from Bob, along with a capacitor to be rated and returns to his 100 KW SSB rig, which has been warming up for 30 minutes. It takes only a few minutes to jig up for the test, then excitation is applied to the proper output level. Now he settles back for the long, dull, but very exacting job of determining just how much current and voltage this capacitor can be expected to handle. A man of less experience could have trouble with this job. It is very easy to get wrong results that look correct. A crystal ball and a witchcraft license are probably part of Lloyd's regular equipment.



Bert Newkirk WA6 SIX inside power supply enclosure of 25 KW output 600 Mc Klystron transmitter.

Leonard is one of the younger operators. He took two years of college, but family responsibilities dictated that he go to work and take his college on a part time basis. He will likely get his BA or EE some day, but in the meantime he is a test operator in the RF testing Lab. He is an excellent testing operator, but his academic ability is constantly being used to real advantage in compiling and analyzing test results for condensed reports. This is a rare ability seldom found in non-college graduates.

Among the younger operators, but a veteran of several years testing, is Roy. Of course he is an avid ham. He was net control of one of the MARS nets for over a year. Today, he will spend several hours running a 600 mc, 25 KW output klystron to test some switches that are destined for high powered radar use. Later in the day, he will likely run some rf voltage tests on some capacitors, a part of getting them ready to ship to customers. Of course, at any time, some special "hot" job may come through and Bob may very well put Roy on it.



Bert Newkirk WA6 Six and Tut Tuttle WA6 LUM adjusting switches on a 500,000 watt power supply.

The youngest member of the family is Dick. (Naturally, he's a ham—in fact that was his only qualification when he arrived a couple of years ago.) Now he is literally growing up in the job. He operates any of the dozen or so rigs including the 100 KW rig. But lately, he has tended to specialize in high voltage dc testing. He takes a tray of capacitors and applies 50 to 100 KV dc to them to determine their ability to withstand dc.

Howard is one of Bob's most valuable test operators. He retired from the Quartermaster Corps as a major several years ago and decided to start over in a new line so he went to work as a jr. electronic technician. Practically his only qualification was his desire. He has made out very well. Most of his training was on the job, but he took some night school courses and studied at home on his own. His maturity is to his advantage. Hasty judgment in the testing field can be very expensive. Now, Howard specializes in high power dc switch testing. His two main pieces of equipment are a 13,000 volt dc at 50 amps power supply, which can be overloaded to 200 amps on short duty cycles, and a 75 to 100 KV dc supply rated at 7 amps continuous, but often operated at 20 amps for a quarter of a second or so. The 100 KV supply uses a 50 horsepower fan to cool the load resistors.

For better utilization of the equipment, two men (and sometimes more) work a night shift. Bill and Henry work as a team on the night shift, running whatever equipment is necessary for the test at hand. Bob tries to keep Bill and Henry on catalogue rating work, but often he has to use them for other "hot" tests. Both Bill and Henry learned most of their technical know how on the job.

With testing for the day under way under Bob's eagle eye, Tut turns his attention to some of the technical problems before him.

There are some special set ups to be done on the 300 kc rig. A cranky time delay relay on rig #3 is clamoring for attention. A 5 KW exciter being built for some special tests needs "eyeballing" before it goes much farther. There is some clean up work to do in the transformer's yard, etc. There is no end of jobs that he would like to get done. By carefully hopping from job to job, Tut keeps the hottest jobs going and even gets some of them finished now and then. He knows he can never get it all done, but as long as he doesn't fall too far behind, he feels he is doing OK.

There are three college part time workers. They will likely be engineers some day, but now they are getting experience and going to

college. One of these men, Bob, of course a ham, Tut puts on the special 300 kc set-ups. Bob will likely stay on this special low frequency testing all summer, operating the 5 KW rig, changing set ups, repairing the rig, making reports, etc.

Another college man, Rudy, has been assigned recently to some special low power dc testing, of a type that a sharp ham/college man would be good at. Rudy has shown a particular aptitude with transistors, so he has been called on to design and construct transistor gear for the lab several times. It was desired to hear what was going on in one of the test cabinets that had to be kept closed during testing for safety reasons. So, Rudy made a little audio amplifier with microphone and speaker, using transistors, to monitor the testing sounds in the enclosure.

Dave, another college man, has worked part time the longest. He is letting his college work "age" a bit. In fact, he may never finish, and the world will have lost a fine engineer to the technician ranks. Dave has helped build most of the equipment in the lab in the past 3 years. Today, Tut puts him to checking out a truckload of large transformers just received to be used in various large power supplies. Some time during the summer, Dave will be a high-climber and paint the 100 foot steel antenna tower that the lab's 20 meter beam is topping off.

Tut has two journeyman technicians that can build or repair anything that comes along. Both migrated to the west about 2 years ago with considerable electronic experience behind them. They broke in very quickly and were earning their pay in a few weeks.

One of them, Bert, a ham of many years standing, goes on with his present assignment of building a 25 KW autotune amplifier to be shown at the fall Electronics show. The other one, Ernie, a ham, of course, has just completed a 5 KW rig so he and a junior technician are working on installing a 20 KW bandswitching rig.

The junior technician, Ron, started a few months before with his only qualification being a willingness to learn. He is picking up shop practices and construction know how under Tut and the other more experienced "experts." He will be an expert himself in a couple of years.

In this lab, a strong effort is made to determine the strengths of each worker, and then play to those strengths. There is such a variety of jobs to do that there is usually enough of the right kind of work for each kind of worker

with some left over.

The main requirement is that a worker be eager and willing. If he is eager and willing, he can learn. Actually the work in each lab tends to be so special that a new worker has to be broken in almost from scratch even tho he has some experience. However, the man with experience will break in much quicker.

It costs a company a great deal to train a technician. Therefore, a company will try to select a prospective trainee very carefully before investing in his training. Any evidence of instability such as previous job hopping will count against him. Usually there is a probationary period for new employees. During this time, the company can size him up, and if they don't like what they see, they can let him go with little or no explanation. Once accepted as a regular full time employee, it is not as easy (from a supervisor's standpoint) to let an employee go. Seldom is an employee clearly and definitely "no good." This kind of worker would have been weeded out in the first few days of his probationary period. It is more common to find a man to be not as good as you had at first hoped he would be. But it may be difficult to find sufficient reason to satisfy the personnel office that the man should be let go. Therefore, a supervisor really takes a look during that probationary period of a new man. Once accepted, if a worker becomes a small problem in one position, it is best to protect the company's training investment by trying the worker at a different position. This often works out very well to the company's and to the worker's best interest.

The first step is usually the hardest—getting your foot in the door. For a new, inexperienced worker, it is best to "take what you can get," even perhaps not directly an electronic job, to get into a desirable company. Then, after you have shown your willingness to work, you will likely be able to transfer into electronics when there is an opening. This opening problem is often a major obstacle. Everyone wants to get into the act, so there are not always openings.

Many good technicians, working for a good company, have found that if they have genuine interest in their work, show willingness to work and learn, and when the time is right, a willingness to accept responsibility, the pay and promotions are taken care of without worry on their part. The worker who will work harder *after* he gets more pay is not likely to to get the promotion. The worker that makes himself valuable to the company is the one who gets the promotions. . . . W6JAT

Selected Circuits

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The ALTEC 460A Transistor Compressor Amplifier is typical of the transistorized, modular audio assemblies. All are housed in identical, plug-in cases.

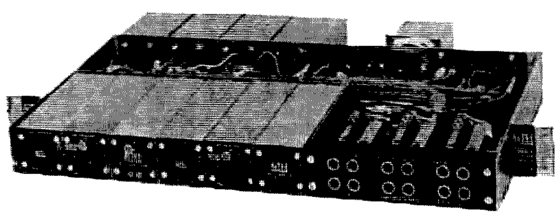
The communications industry has long recognized the practical utility and flexibility of modular or "building block" construction. Even the most complex multi-channel carrier systems consist of large numbers of relatively few types of circuits inter-connected to meet specific system requirements. Where minor differences occur, such as oscillator and filter frequencies, these elements are often made plug-in to permit fullest flexibility in manufacturing, installation and maintenance.

The ALTEC Lansing Corporation of Anaheim, California, manufacturers and markets a line of compart, modular plug-in units to meet the requirements of the telephone industry. This line includes transistorized line, compression and power audio amplifiers. The circuitry of these audio components is of particular interest to amateurs who may desire to pattern their construction projects along these lines. The ALTEC line is rounded out by a series of attenuators, equalizers, line transformers, hybrids and networks of similar construction.

These individual system elements are housed in compact, plug-in cases. The basic package is similar to the Western Electric V-3 vacuum tube line amplifier. This unit is used in great quantities by the telephone companies as repeater amplifiers. The compact construction of these units is shown in the photograph of the ALTEC 460A Transistor Compressor Amplifier which measures 1¾" x 1¾" x 6".

The various units may be mounted and interconnected to meet specific system requirements. An example of this is shown in the photograph of the ALTEC 7300A Telephone Repeater Terminating Unit. While other assembled packages are available, probably the greatest use of the line amplifiers is to replace existing vacuum tube amplifiers or to expand existing installations. Several models of the basic transistor line amplifiers are available for operation from various supply voltages. Other variations include dual input and output impedances with optional simplex taps on the transformers and monitor output options.

The ALTEC 457B Transistor Amplifier is typical and the schematic is shown in Fig. 1. This unit provides 37 db gain from and into 600 ohm loads and delivers a maximum output power of +18 dbm. Distortion is low and output is flat within 1 db between 200 and 3,000 cps.



Typical grouping of the modular assemblies is shown in the ALTEC 7300A Telephone Repeater Terminating Unit. The units are easily removed for service.

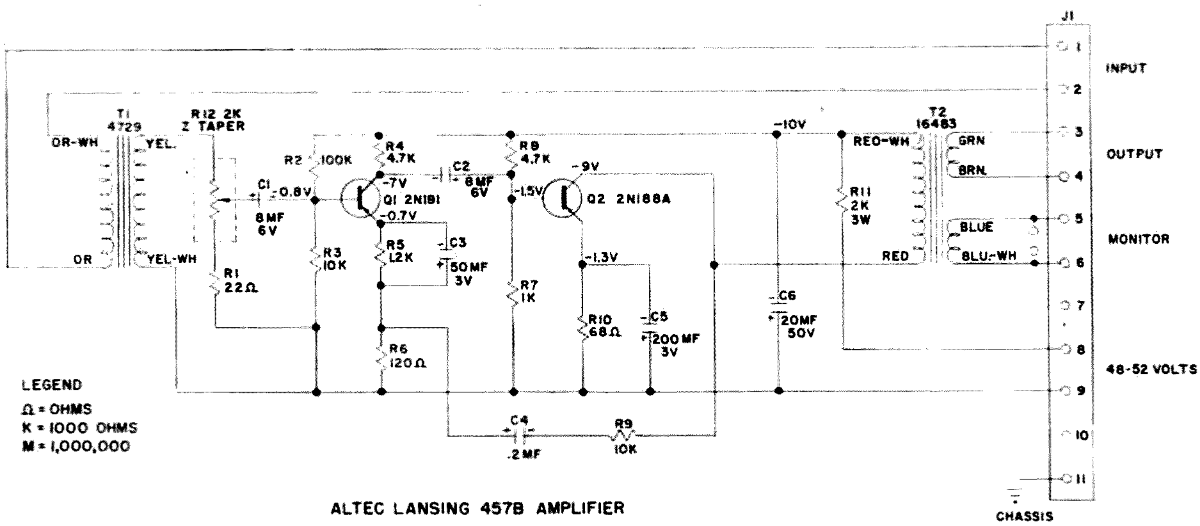


Fig. 1 Schematic diagram of the ALTEC 457B Transistor Amplifier. This little unit provides 37 db gain and has a maximum output of +18db. Gain may be increased to over 50 db by opening the C4-R9 feedback loop.

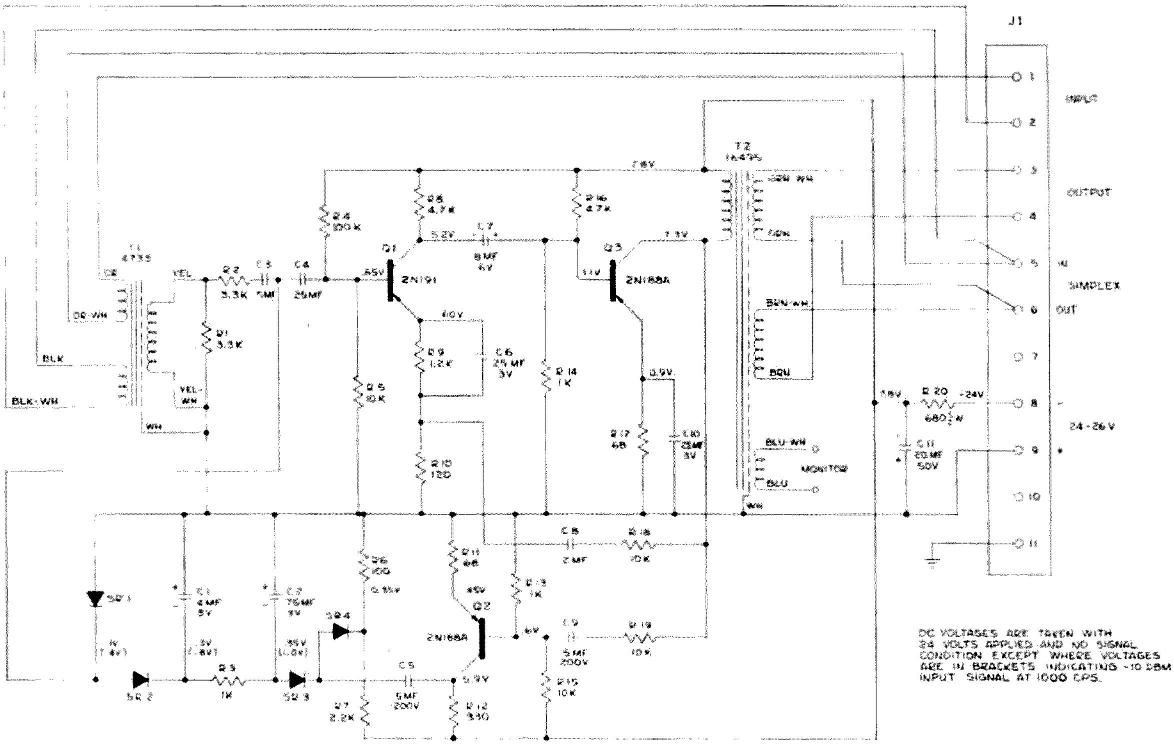


Fig. 2 Schematic of the ALTEC 460A Transistor Compressor Amplifier. While designed for telephone repeater service, the circuit is ideally suited for amateur transmitter applications. Output level varies less than 20 db for an input range in excess of 50 db.

Output noise level is –70 dbm. As designed, the unit draws 25 ma from a 52 volt source. However, the majority of this power is dissipated in the R11 dropping resistor. The actual power requirement is approximately 25 ma at 10 volts. Heavy negative feedback is utilized to reduce distortion and stabilize the gain of the amplifier. Gain is constant within 0.3 db for a 25% variation of supply voltage and within 0.2 db for an ambient temperature increase from 75° F. to 110° F. While the circuit is usable, as is, for many amateur applications, more gain may be required for others. For these applications, gain may be increased to more than 50 db by opening the C4-R9 feedback loop. While this will make the gain of the amplifier more susceptible to temperature and supply voltage variations, no great difficulty should be encountered in fixed installations.

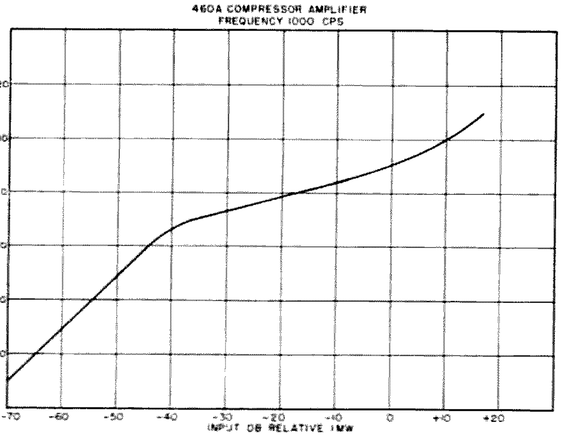


Fig. 3 Performance curve of the ALTEC 460A Compressor Amplifier. While designed for automatic equalization of telephone circuit levels, it is ideal for amateur speech applications.

The ALTEC 460A Transistor Compressor Amplifier is designed for use in communications systems, where it is desirable to maintain a relatively constant output level for a wide range of input levels. Since the problem is similar to that encountered in amateur transmitter speech systems, the circuitry of this unit, shown in Fig. 2, should be of amateur interest. As in the line amplifiers, input and output impedances are 600 ohms. Below compression, the gain of the amplifier is approximately 35 db. Compression characteristics of this amplifier are shown in Fig. 3.

The last of the ALTEC units to be described is the type 461A Transistor Power Amplifier. This compact little unit is housed in the same style package as the other units and will deliver 2 watts output into an 8 ohm speaker. The amplifier is designed for use in a speaker type, telephone terminating set but the circuit should be valuable in amateur audio work. Fig. 4 gives the schematic diagram of this little amplifier. Input impedance is the standard 600 ohms which makes it compatible with the other units described.

While the writer is certainly not recommending that every amateur go out and buy a truck load of these ALTEC audio components, there is much to be said for the modular concept employed in their design. Think it over carefully. You may want to use modular packaging in your next construction project.

. . . W4WKM

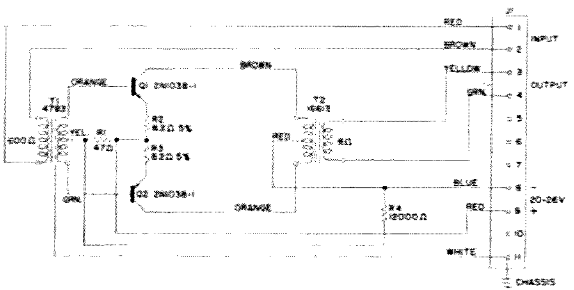


Fig. 4 Schematic of the ALTEC 461A Transistor Power Amplifier. This modular building block provides 2 watts of audio to an 8 ohm speaker.

Diode Modulators

Staff

One of the first points at which SSB construction details vary drastically from the older AM techniques is in the wide use of diode modulators with SSB.

This sometimes causes much head-scratching and consternation among sideband neophytes. Who ever heard of a diode being able to modulate a signal?

However, as many, many on-the-air signals will testify, it works. And it works quite well, if a few simple precautions are followed.

Before we dive into the depths of the several diode-modulator circuits available for our use, let's settle this question of how a diode can act as a modulator:

To do this, we'll have to back up and examine first the differences between ac and dc. For our purposes, the essential difference is that ac voltages go *equal* distances either side of zero on adjacent half-cycles. If you have an ac voltage which goes farther positive than negative, it's not true ac—rather, it's ac superimposed on a dc component.

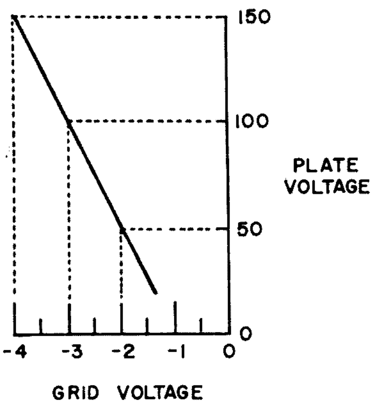


FIG. 1

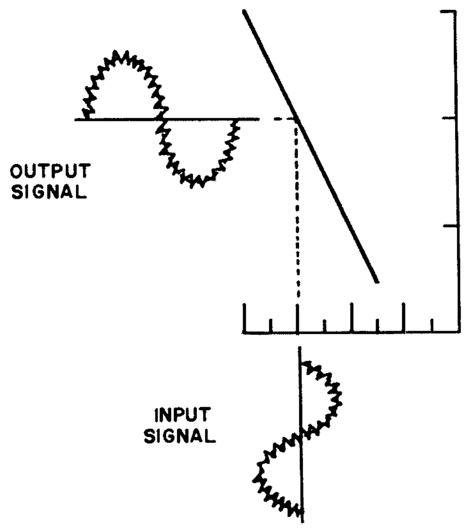


FIG. 2

Let's look at this a little more closely. Take an ordinary amplifier and feed some ac into the grid circuit. What do you have at the plate? If you answered "more ac," go to the foot of the class. Your amplified ac is there, to be sure, but the dc plate voltage is also present—and if the amplifier is working within its limits, the absolute voltage at any instant will never go below zero so the voltage at the plate cannot actually "alternate."

Now couple off the amplified signal from the plate, through a capacitor. What do you have now? The dc cannot pass through the capacitor, and as a result only the ac component gets through. It swings equally above and below zero; it is *true* ac.

What does all this have to do with modulators? To answer this, we have to draw a couple of pictures of "transfer characteristics."

The "transfer characteristic," for those un-

familiar with the term, is simply a graph which shows output voltage of a circuit in relation to input voltage. For a triode amplifier, it would read instantaneous plate voltage on the vertical scale in relation to instantaneous grid voltage on the horizontal scale (Fig. 1).

Taking that amplifier in Fig. 1, let's examine it. The graph says that when the grid voltage is minus 3, plate voltage is 100. When grid voltage is minus 2, plate voltage drops to 50. When grid voltage is minus 4, plate voltage rises to 150.

Such an amplifier is linear, in that the output voltage changes the same amount for equal changes of input voltage. What goes into a linear amplifier comes out unchanged.

Now, let's put two ac tones into the input of this amplifier (Fig. 2). The two tones are completely separate, and as a result neither of them is true ac; the higher-frequency tone "rides" the lower-frequency one. So far as the higher tone is concerned, the lower tone is its zero-voltage reference. But since the amplifier is linear, the tones come out unchanged.

At this point, let's take a look at the transfer characteristic of a perfect diode. It's shown in Fig. 3. Note that, unlike our amplifier, this characteristic is *not* a straight line. It has a sharp break in it; the sharper the break, the better the diode.

Now, in Fig. 4, let's apply those same two ac tones to the diode. When the input signal swings positive, the diode conducts and an output signal appears. When it swings negative, nothing happens. Thus, the output signal is *not* a replica of the input. The diode is said to be "non-linear."

Note that in all four illustrations, the output signal is *not* true ac. All have some dc components present. However, passing them through a capacitor will remove the dc and the output will then be true ac.

The output of the diode, when treated in this manner, becomes completely true ac; it's

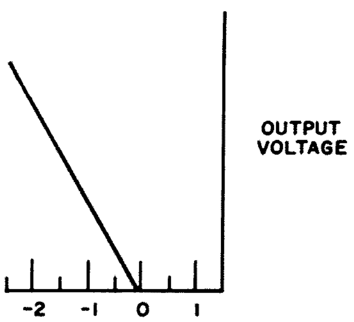


FIG. 3

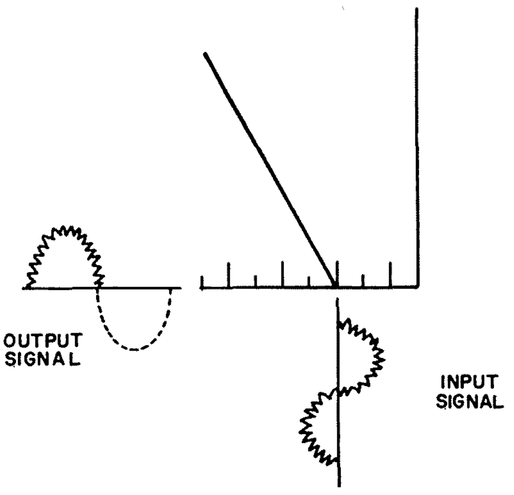


FIG. 4

no longer a pair of separate tones. The lower-frequency tone has *modulated* the higher one. And that's how a diode can modulate.

One point deserves careful attention. For our diode to act as described, the levels of all the signals must be very carefully controlled and bias level on the diode is also critical. This is never a difficult thing to do, but since it is so vital to proper circuit operation deserves this special mention.

The simple single-diode modulator we just discussed is a basic diode modulator. It could be used for amplitude modulation of a low-level signal, or for a mixer in a receiver, but it is not especially useful in sideband. In a sideband modulator, we want to get rid of the carrier at the same time.

A number of circuits which will do this have appeared in the literature, under the common family name of "balanced diode modulators." They may be divided for study into several categories, but unfortunately authorities differ on these categories.

Collins Radio Company, in their excellent manual "Fundamentals of Single Side Band," declare that only three types of diode modulators exist: ring, shunt, and series.

Going on to the ARRL publication, "Single Sideband for the Radio Amateur," we run into a fourth type—the bridge modulator. Except that this bridge modulator is identical to the one Collins calls a series circuit, and the circuit known as the series circuit in most references is not included in the Collins manual! Confusion is still rampant in the field, apparently.

So we won't try to classify the types here. We'll simply go through the published references, describe the workings of each, and list some advantages and disadvantages as reported in the original scattered descriptions:

The Ring Modulator. This modulator is usually referred to as the "classic ring" circuit, since it was developed by telephone engineers in the very early days of commercial sideband and is possibly the oldest balanced-modulator circuit. A typical ring-modulator circuit is shown in Fig. 5, and one suitable for ham use in the 455 Kc region appears in Fig. 6 with parts values.

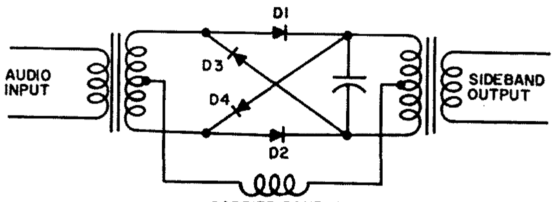


FIG. 5

According to the Collins reference, the ring modulator has the highest efficiency of all diode balanced modulators, being able to provide twice as great an output voltage for the same inputs as the other types of modulators. However, as Hooton points out, the diodes must be more closely matched in this circuit to obtain satisfactory carrier suppression than is necessary with other circuits which contain balance adjustments.

Here's how the ring modulator works: both the audio input and the sideband output are push-pull circuits, while the carrier input is single-ended. In the absence of any audio signal, the carrier is balanced out in the output tank. When carrier voltage at the audio-input center-tap is positive, rf current will flow through the output tank (from center-tap to both ends), D1 and D2, the audio transformer, and back to the carrier generator. When carrier voltage at the same point is negative, current flow reverses—but in either case, the current flow through the output tank is from center-tap to both ends at the same time. This means the potential at each end is the same, and with no voltage drop across the entire coil no output current flows.

Application of audio signal to the transformer modifies this action to some extent. Now diodes D1 and D2 no longer conduct at

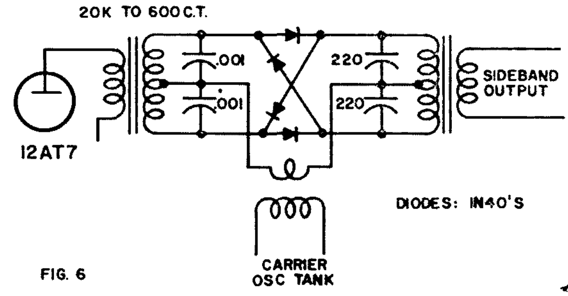


FIG. 6

exactly the same times; the one which tends to be turned "on" by the audio signal conducts for a longer time than does the one which tends to be turned "off." The same is true for D3 and D4. Now, current from the carrier generator flows for a longer period through one half of the output tank primary than through the other. The result is a series of pulses in the output circuit, whose polarity and frequency are determined by the carrier, and whose height is determined by the audio. After passing through the tank circuit, these pulses are not distinguishable from the sideband components of an AM signal.

Input and output impedances of the ring modulator are low, according to Stoner. Figures in the neighborhood of 600 ohms are usually quoted. For the audio input, a plate-to-600-ohm transformer is satisfactory; for the sideband output, much more capacitance than usually used would be indicated.

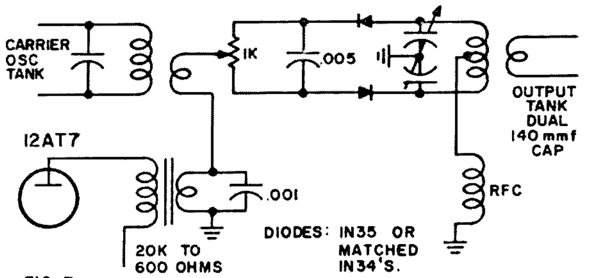


FIG. 7

Stoner describes also a "modified ring modulator" which was used in W2KUJ's "SSB-Jr." exciter described in a 1950 issue of GE *Ham News*, and later in the Central Electronics line. The circuit for this modulator is shown in Fig. 7.

In this circuit, carrier and audio frequencies are applied, in series, to the arm of balance pot R1. The voltages appear at each end of this pot, in ratio determined by the setting of the potentiometer, and pass through diodes D1 and D2.

In the absence of audio signal, the carrier passes through the bypass capacitor; this places the rf voltage across the diodes at the same level on each side, and as a result no rf current flows.

With audio applied, the diodes are unbalanced in the same manner described for the classic ring, and sideband-signal current flows through the output tank.

The rf choke from output-tank center-tap to ground is essential; without it, no carrier balance is possible. In addition, the audio transformer should be by-passed for the carrier frequency. The carrier-injection link usually has no effect on the audio.

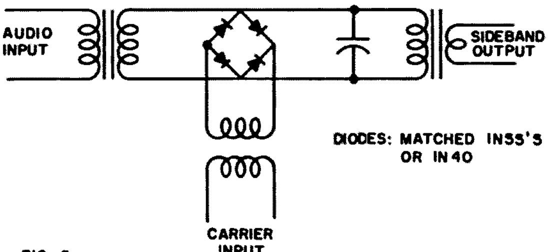


FIG. 8

The Bridge Modulator. For understanding more clearly how it's possible to balance the carrier out, there's nothing like a study of the bridge balanced modulator.

As the name implies, this modulator (Fig. 8) is based on the Wheatstone bridge, with diodes replacing the usual resistance arms.

Audio input and the sideband output are taken from the same set of terminals, while the carrier input is applied to the remaining terminal set. If all diodes have identical characteristics, the bridge will be in balance at all times (if no audio is applied) and the carrier will find no path to the output.

However, application of audio will affect the diodes in the upper half of the bridge differently than those in the lower half, because of diode polarities—and the bridge is no longer balanced. The signal finds its way from carrier input to sideband output.

To understand how this is sideband signal, rather than pure carrier, you have to go back to the basic diode modulator and note that all signals reaching the output consist of *both* audio and carrier, and all have passed through at least one diode before reaching the output.

The bridge is seldom used in practice any more, since it (like the classic ring) requires four diodes and equally satisfactory results may be had from either the modified ring, the 2 diode shunt, or the 2 diode series modulators. For this reason, no "practical circuit" with parts values is included.

The 2 Diode Shunt Modulator. The 2 diode shunt modulator is similar to the bridge type except that the two lower diodes are replaced by a push-pull carrier input. A typical circuit is shown in Fig. 9.

The key feature of this modulator is that the carrier signal causes the diodes to short out the audio signal. Depending on carrier-half-cycle polarity, the pulse in the output tank will be either positive or negative going. For the shunt modulator to operate properly, great care must be taken with circuit impedances.

For instance, all diodes (in practice) have some forward resistance. Their back resistance, also, while high is not infinite. Thus, if the audio signal source impendance is too low the diode will not "short it out," while if audio impedance is too high the inactive diode will still tend to short out the signal.

This is the reason for the 1,000 ohm resistor shown in Fig. 9. It establishes 1,000 ohms as the circuit source impedance. This is a good compromise value for most diodes.

Diode balance in this circuit is not especially critical, since a balancing adjustment is provided. If you are limited in your choice of diodes, match them for *forward* resistance only and you won't have too much trouble.

The 2 Diode Series Modulator. The 2 diode series modulator shown in Fig. 10 appears, at first glance, almost identical to the shunt modulator of Fig. 9. However, it works in a radically different manner.

Where the shunt modulator uses the carrier to short out the audio, the series modulator uses the carrier to establish a signal path through which the audio can travel.

So far as we have been able to determine, this circuit was first described by Fred Berry WoMNN in the September 1952 issue of QST. It has since been republished in almost all sideband manuals.

Like the shunt modulator, this circuit requires fairly well matched diodes so far as the forward-resistance characteristic is concerned. However, this resistance need not be excep-

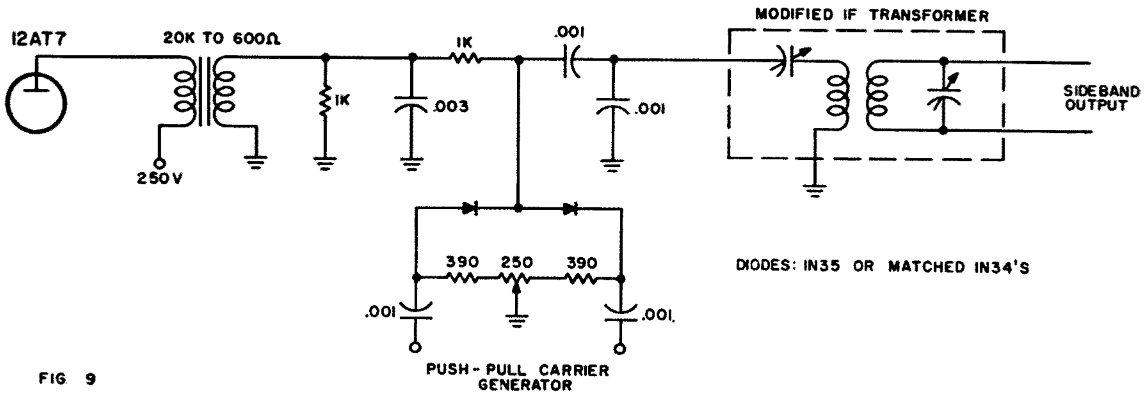
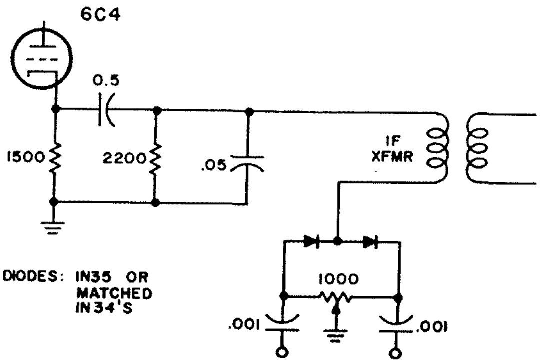


FIG 9



PUSH-PULL CARRIER GENERATOR

FIG. 10

tionally low; the original circuit used vacuum-tube diodes instead of semiconductors!

The major disadvantage of the series or shunt modulators is the requirement for push-pull carrier injection. In a filter-type exciter, this is no particular problem, and as a result these modulators are widely used in filter rigs. However, phasing becomes slightly more difficult with these circuits—so most phasing rigs end up using the modified ring circuit which allows single-ended carrier injection.

Up to now, we have simply discussed the circuits without much mention of their place in the overall scheme of sideband. Naturally, the major use of diode modulators is in generating the original set of sideband signals from audio and a carrier—and in all our descriptions we have taken this for granted.

But the balanced modulator has many other uses; it can be used anywhere you would use a mixer (mixing and modulation are two names for the same process) and frequently such use makes circuit design much simpler.

In a receiver, using a balanced modulator means you have one signal (the local oscillator) you don't have to worry about getting through the *if*. As a product detector, a balanced modulator eliminates any worries about overloading the audio section with the BFO injection.

However, diode balanced modulators are only half the story. Balanced modulators can be—and are—built with active devices such as tubes and transistors, also. Such active modulators offer a wider variety of subjects—and that's the subject of the next instalment.

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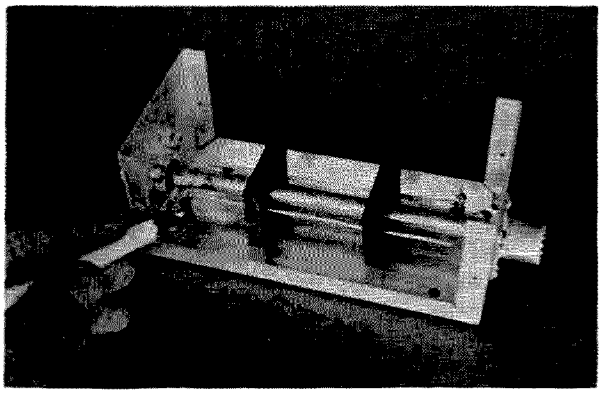
Fred Blechman K6UGT
23958 Archwood Street
Canoga Park, California

73 Tests

the Knight-Kit P-2 SWR/Power Meter

Standing wave ratio is a subject of discussion and controversy on the amateur airwaves, and is of special concern to those limited in transmitter power. Like the weather, everyone talks about swr, but no one seems to know much about it! However, Allied Radio (100 N. Western Ave., Chicago 80, Illinois) has just made a new Knight-Kit available which is bound to stir up the curiosity of newcomers and old-timers alike regarding swr.

The P-2 SWR/Power Meter Kit (Catalog # 83 YX 627R) sells for $14.95, and consists of two units, a 2 x 5 x 2½ inch coupler and a 2⅞ x 6¼ x 3 inch indicator, connected by a 4-foot shielded cable. Standard SO-239 rf coaxial receptacles are part of the coupler unit, which may be left in the transmission line permanently with negligible power loss.



The "coupler" is built in a separate enclosure, with standard coaxial connectors to allow convenient attachment to the transmission line.

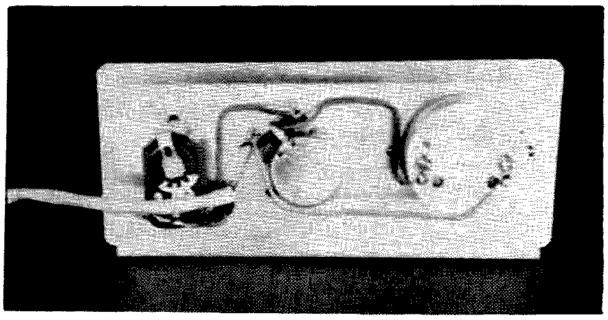
The resistor value used depends on the impedance value of the transmission line with which the coupler is to be used.

The coupler may be assembled for use with either 52 or 72 ohm coaxial transmission line, and may be used from 3.5 to 432 megacycles. No external ac power or batteries are required for its operation. It will handle a kilowatt of rf power, yet requires less than a watt at 432 mc for a full scale reading of the 100 micro-amp meter in the indicator unit. Unfortunately, the red and black meter scales are on a gray background (to match the unit two-tone gray color scheme); a white meter background would enhance visibility in subdued lighting, since the meter is not illuminated.

Assembly of the units is very clearly shown in the detailed assembly manual and the photos accompanying this article. No real problems were encountered in the construction, which takes about 1½ hours if done carefully, as it should be. The author's unit worked perfectly when completed, and no adjustments were required.

During construction of the indicator unit, it would be wise to mount the knobs on the power switch and sensitivity potentiometer shafts right after placing the meter dress panel on the meter sub-panel. This makes it much easier to handle the panel as it is being installed in its case. The black sheet metal screws used to hold the rubber mounting feet are rather brittle, and should be installed without too much "brute force" to avoid breaking the tips of the screws. Also, avoid over-tightening these screws, or they will go *through* the rubber feet; just tighten until the feet are snug, or use a flat washer under the head of each screw.

When assembling the coupler, the place-



The complete wiring of the indicator sub-panel involves only a few wires, and a 2-conductor shielded cable which goes to the coupler unit.

ment of several of the parts is critical, and the instructions should be followed closely. Two sets of resistors are supplied with the unit. If you intend to use the coupler with 52 ohm transmission line use the 160 ohm resistors; for 72 ohm line, use the 100 ohm resistors. If the parts tend to shift during handling, use pencil marks on the copper rod and chassis to allow you to return the parts to the proper location when ready to solder. The coupler has no markings on it, and it would be wise to mark J1 XMTR on the end with the connecting cable, and J2 ANT on the other end.

The schematic diagram of the P-2 SWR Meter is shown in Fig. 1. The design of the instrument follows that of the time-proven and justly popular Monimatch of QST and ARRL Handbook fame. This instrument, sometimes known as a reflectometer, consists of a short section of coaxial transmission line with two pickup loops which are connected to rf voltmeter circuits. One of these circuits is so positioned with respect to the center conductor of the transmission line section as to read the incident or forward power component of voltage in the line while the other reads the reflected component. In the P-2 instrument, the circuit associated with diode CR-1 is the forward power voltmeter and the circuit associated with CR-2 is the reflected power voltmeter. Resistors R-1 and R-2 must be adjusted to match the characteristic impedance of the line being measured to balance out the undesired voltage component. In use, the instrument is switched

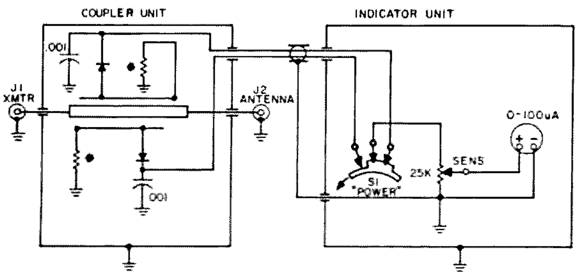
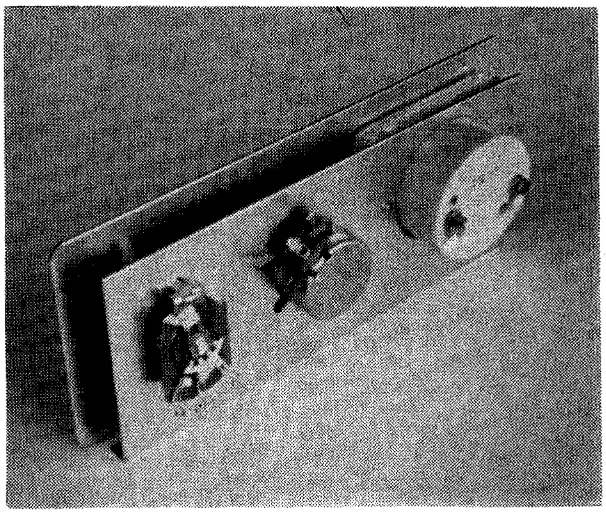


FIGURE 1



The indicator unit contains a sub-panel to hold the meter, switch and pot, with a "dress" panel for the nomenclature.

to the forward power position and the sensitivity control adjusted for full scale meter deflection. The instrument is then switched to the reflected power position and the existing standing wave ratio read directly from the meter scale.

In use, the J1 receptacle of the coupler is connected to the transmitter output connector (using a jumper cable or a double-male connector) and J2 goes to the transmission line feeding the antenna. The transmitter is turned on and tuned in the normal manner, with the sensitivity control on the indicator unit positioned to keep the meter on scale. (The swr meter Power switch must be in the Forward position. You can peak your transmitter output very conveniently by tuning for maximum deflection of the swr meter). Adjust the sensitivity control, once you are tuned up, so the meter reads CAL. (full scale). Now switch the Power switch to Reflected, and read the swr directly on the meter top scale. Although the operating instructions fail to mention it, the REL. POWER scale of the meter, if multiplied by 10, reads the percentage of reflected power! Notice that only 11% power is reflected at an SWR of 2.0, and 25% is reflected at SWR of 3.0. You may calculate the reflected power percentage quite simply from the SWR reading:

$$\%\ \text{Reflected power} = \left(\frac{\text{swr}-1}{\text{swr}+1}\right)^2$$

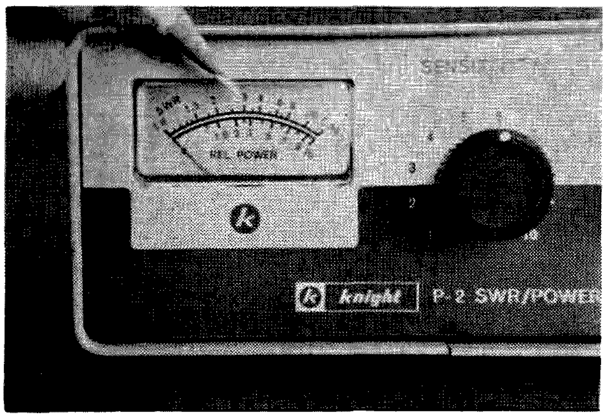
The forward power (that's the power actually getting out) is then found by subtracting the reflected power percentage from 100%.

The fact that the meter of the P-2 SWR Meter is calibrated in relative power deserves

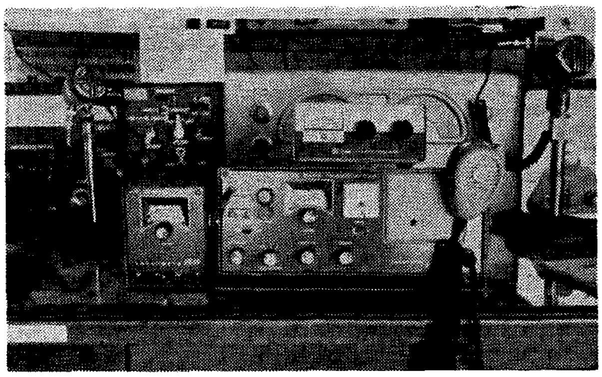
some explanation. The reflectometer type of SWR meter is quite dependent on frequency for any given output indication. Note that 45 watts is required for full scale deflection at 1.8 mc while only ½ watt is required for full scale deflection at 432 mc. This ratio is perfectly normal for this type of meter. However, it prevents the inclusion of absolute power scales in an all band instrument. Despite this, the relative power scale is quite convenient for transmitter tuning, etc.

The calibration of the completed unit may be checked several ways. The instructions go through an alignment procedure which requires a non-reactive dummy load. At the higher frequencies and for high power this might pose a problem. A simple way to make a quick check is to *reverse* the coupler in the transmission line, connecting J2 to the transmitter output, and J1 to the transmission line. Now set CAL on the meter with the Power switch in the Reflected position, and read swr in the Forward position. If the same swr is obtained as using the coupler the correct way, the unit is well balanced. If not, the position of the diode connections to the pick-up wires in the coupler must be adjusted slightly, as described in the manual. The author's unit required no adjustments.

Be careful about quoting your swr readings with too much certainty. You see, it just so happens that the swr read at the transmitter is *always lower* than the actual swr at the transmitter. The reason is simple: the forward power is attenuated on its way to the antenna by line loss, and the power reflected at the antenna is also attenuated by the transmission line on its way back to the transmitter. Therefore, the percentage of reflected power reaching the swr meter is less than it should be, compared to the outgoing forward power.



The meter is calibrated to SWR of 20. The lower scale, multiplied by 10, reads percent reflected power. For example, at SWR of 3, 25% power is reflected from the load.



A typical "neat" station!

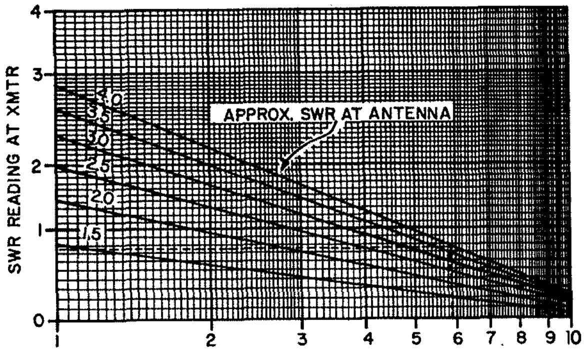
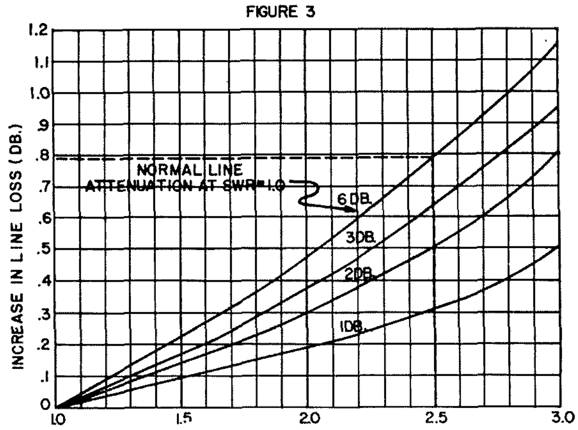


FIGURE 2

FIGURE 3



Since the swr meter is usually located at the transmitter, this variation can be considerable. Look at Fig. 2 for a shock. If the basic transmission line loss (at swr of 1.0) is 6 db, and the swr at the antenna is 4.0, the swr meter will only read 1.37. You can estimate your basic line loss from tables that list the loss per 100 feet for different types of transmission line at various frequencies; the *Radio Amateur's Handbook* has this information in a graph in the transmission line section.

Swr has a couple of other villainous features: it increases your transmission line loss, and lowers the power limitation of the transmission line. Fig. 3 shows the added loss to a transmission line due to swr. For example, if the line loss at swr of 1.0 is 6 db, but the actual swr at the antenna is 2.5, the line loss will be increased by another .79 db. At higher swr this effect can be a lot worse; at swr of 10, with a basic line loss of 6 db, the increase in loss will be 4.5 db. As for the power limitation, caused by the increased peak voltages of the standing waves, the allowable power is equal to the rated power (at swr of 1.0) divided by the swr:

$$\text{Allowable power} = \left(\frac{\text{Rated power}}{\text{swr}}\right)$$

Generally speaking, unless you have high transmission line losses to begin with, an swr of 3.0 or less will make very little difference at the receiving end. Remember, one S unit is 6 db. at the receiver. But it all makes for good conversation on the air.

Specifications of the Knight-Kit P-2 SWR/Power Meter

Minimum rf power for full scale deflection	**45 watts at 1.8 mc** **½ watt at 432 mc**
Maximum rf power	**1 kilowatt**
Input and output impedance	**52 or 72 ohms**
Power requirements	**none**
Frequency coverage	**1.8 to 432 mc**
Meter sensitivity	**100 microamperes full scale**
Meter scales, standing wave ratio	**1:1 to 20:1**
Relative power	**0 to 10**
Kit assembly time	**1 to 2 hours**
Cost	**$14.95 in kit form**

(NSD/1 from page 57)

got the QSL Club was this: "It is not permissible for two or more persons . . . to establish a system . . . to reduce the amount of postage they pay, by assorting, grouping and mailing in one envelope their . . . letters to be forwarded to one customer . . ." This means that it is illegal for a person or group to receive bulk mailed QSL's, sort them out and remail them in groups to the addressees. This is terrible.

How come our government is blasting away at monopolies wherever possible in business and yet chooses not to practice what it preaches. It seems to me that some competition could do the P.O. a lot of good. If they had to automate to keep business going they would soon be able to give us service on the order of that which you get in Europe . . . and they make our service look sick.

Boy Out Back

Last month, in a burst of enthusiasm, CQ's publisher opined that they actually have more active hams reading CQ than QST. Since we only have their hilarious "sworn statement" to go by . . . their true print run and circulation are closely guarded secrets . . . we have to figure out what is going on by other indications.

For instance I judge by little things such as the dropping number of ads, the tremendous falling off of mail-order advertising which is a sure indication of the effectiveness of a magazine, the inability to continue providing the half-cent wrapper for subscriber copies, the cutting down for the first time in years from 128 pages to 112 pages, the use of the cheapest paper I've seen yet in a ham magazine, the loneliness at CQ booths at conventions, and leaks from members of the CQ staff.

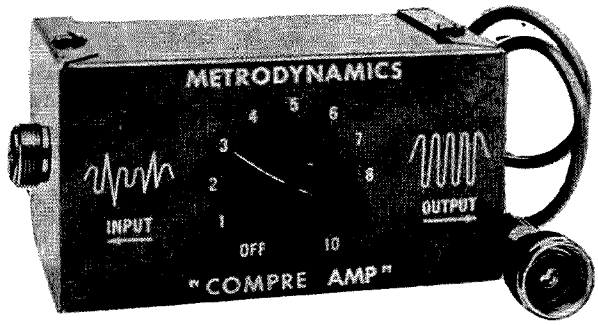
Putting all this together with candid comments by advertisers who have compared results recently between the two magazines I come to the conclusion that QST must have about 2.3 times the circulation of CQ.

K2CM Absolved

Tom McCann K2CM thought I went a little too far in rewriting his review of the Waters Coaxial Switches in the April issue and wants everyone to know that this piece, which he calls "the most inept piece of writing which throughout that I have ever read on a printed page" was written by me and not him.

. . . W2NSD/1

73 Tests The



Wayne Green W2NSD/1

Listening in on our bands, one might be inclined to suspect that amateurs are incapable of agreeing on anything. There is one area of rather complete agreement however: our bands are miserably crowded.

There are many approaches to meeting the challenge of trying to get through the QRM curtain. Some chaps string up one antenna after another, others build up rather impressive final amplifiers, some just build bigger modulators, some wait until the wee hours of the morning, etc. But, even after you've moved to that salt marsh on top of the mountain, put up the hundred foot tower with the twelve element beam, and done everything else known to man to put out a signal, there is still an area for improving the punch your signal puts into that DX receiver.

Naturally you can get the same improvement in punch with any rig. The idea is to increase the percentage of modulation or (in the case of SSB) the average power output without creating the splatter that accompanies your turning up the gain control. When you try to get through a little better by increasing your mike gain you flattop on the positive peaks and clip on the negative peaks. The result is a bandful of furious hams and not much improvement in your ability to get out.

There is, of course, nothing really new about using clippers or compressors to increase the modulation percentage of transmitters and many designs of both have been around for a long time. The Metrodynamics Compreamp is a much more modern application with a two transistor logrithmic compressor, matched silicon diodes in the clipper and a cleverly designed RC filter to eliminate the harsh resultant frequencies usually associated with clippers. The result is a smoothly working compressor which connects between your mike and your mike jack.

It is obvious that the Compreamp will change the sound of your voice a bit as more compression is used. Thus you would normally

run it with the control in the off position and would increase the compression when fading or QRM become apparent. It sometimes seems almost magical how your voice can get through a seeming solid wall of QRM even though you may be running lower power than a lot of the big boys on the channel . . . unless, of course, one of the big boys has a compressor too.

The Compreamp is small, being transistorized, and costs only $13.95 complete with built in battery. Write Metrodynamics Corp., 8 Westover Avenue, Caldwell, New Jersey for info.

. . . W2NSD/1

LETTERS

Dear Wayne:

Just a couple of thoughts in connection with your proposed junket to Europe this fall. First, I think it is a wonderful idea and all those able to go along should have a wonderful time.

The only fly in the ointment appears to be your choice of a foreign carrier.

What is the matter with a good old US carrier? You know the airlines of this country are having a hard time filling their seats and feeding all the people necessary to operate an air carrier. Just think of the money spent by these airline people for everything from ham gear to groceries.

Another factor is the balance of payments. Our gold is melting away at an alarming rate and it is just such deals as you are cooking up that helps us get further in the hole in this area.

A very large percentage of the fare money will do no one any good in this country, it will go over seas along with the other millions we spend or give to them.

So, while you are pacing up and down your office just think about this a little and I think you will agree that I have a point some where in here.

Only wish I could go with you . . .

. . . R. C. Multon WB6BFR

Yep, it sure is too bad you can't go . . . and maybe find out a little bit of what the world is about. Our gold is melting away because we have inflation here and the U. S. dollar is weakening. I have watched the dollar shrink to a 25c piece in my short lifetime. I work a lot harder for the few dollars I have than most people even imagine and it infuriates me to have Uncle Sugar give them away. but every infuriates me to have Uncle Sam give them away, but every time I spend a dollar in Europe that is a dollar that doesn't have to be sent over as a gift . . . I like it a lot better that way. Now, regarding the use of Sabena Belgian Airlines for our trip . . . let me tell you about that. After letters and phone calls to all U. S. trans-atlantic airlines I found that only Pan Am could handle the cities that we are going to visit. After many phone calls, letters and a personal visit to the New York HQ of Pan Am to see one of the top men in traffic there, I found that Pan Am was "completely sold out" on all charter flights for this year. The only other way they could handle us would cost everyone an extra $75 for the flight and about $100 extra for hotels. So much for all those empty seats. Now, while I was busy trying to force Pan Am to carry us, several other airlines were calling me and trying to sell me on using them. Sabena went so far as to send two men up to our New Hampshire HQ and explain all the things they could do for us. Having travelled both Pan Am and Lufthansa to Europe in the past I had been impressed by the service and hospitality of the European airlines compared to the U. S. lines. There is a tremendous difference in attitude. We are going Sabena and I guarantee that everyone will have a flight whose pleasures they will never forget.

Dear OM:

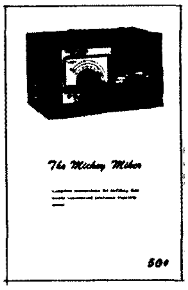
Please put a notice in 73 requesting those Kiiwanians who are hams to send a QSL to me. We hope to establish a Kiiwanis net.

Bob Fleming KGLS
1007 W. Summit
Fergus Falls, Minn.

OK.

73 Products

Peterborough, N. H.



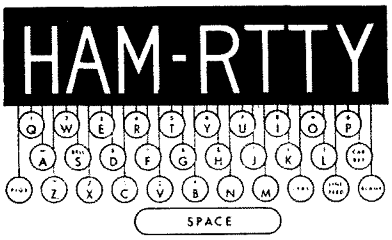
MICKEY MIKER 50c

Complete and exhaustive construction project for building a precision capacity tester. Very thorough.

IMPEDANCE BRIDGE PRINTS $1.00

A complete set of full scale prints (15) of all parts of the precision impedance bridge which originally appeared in the August 1961 issue of 73. Comes complete with a reprint of the original article.

NEW RTTY BOOK $2.00

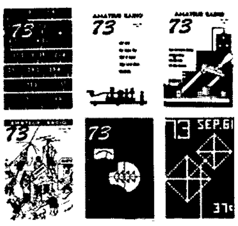


This handbook is written for the beginning RTTY op, but due to the profusion of info, pictures, circuits, etc., it will be valuable to all RTTY'ers and those who may RTTY themselves. If you don't know what RTTY means don't buy it. For $2 what can you lose? It's worth almost that much in paper.

BINDERS FOR 73 $3.00

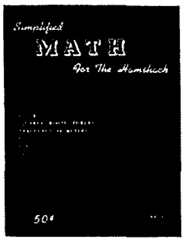
Keep your issues of 73 all in good shape and keep them from straying. Specify year: '60-61, '62, '63. Red Leather binder with gold stamped "73" and year. Darbs.

BACK ISSUES 50c



You can enjoy back issues of 73 just as much as current. Send for one each month to pad out those dreary days. All back issues now available except January 1961. Early issues going to $1 soon. Supply very limited.

SIMPLIFIED MATH 50c



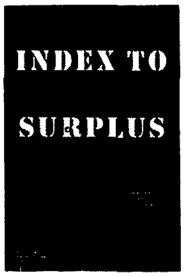
This booklet takes you gently by the hand and leads you through the mysteries of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc., and does it by an amazingly new method.

SURPLUS TV SCHEMATICS $1.00

TV'ers who are interested in saving a lot of construction time and still want to have elaborate TV gear will do well to watch those surplus ads and invest in this booklet, the only source of the diagrams you'll be needing.

CW $1.00

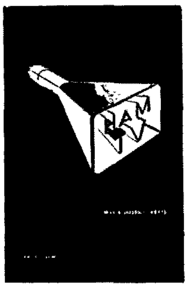
Written by an expert. One of the best methods for learning the code yet devised. Lays in a good foundation for later high speed CW ability. CW can be a lot of fun if you go about learning it the right way. This book will be invaluable to the beginner and the ham who wants to really increase his code speed.



INDEX TO SURPLUS $1.50

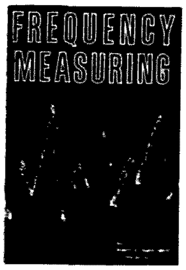
This is a complete list of every surplus conversion article that has ever been published, with a brief description of the conversion. Invaluable bibliography.

HAM-TV $3.00



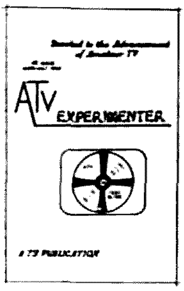
This book gives you a blow by blow description of how to get on the air on TV for under $50. This book is the reason that hundreds of hams are now going on TV. This is not the usual theory book, just a how-to-do-it manual.

FREQUENCY MEASURING HANDBOOK $1.00



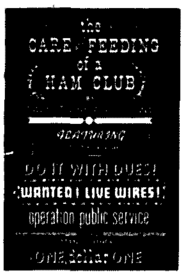
Rather thorough exploration of the subject, complete with an exhaustive bibliography. By WφHKF

AMATEUR TELEVISION EXPERIMENTER $1.00 per year

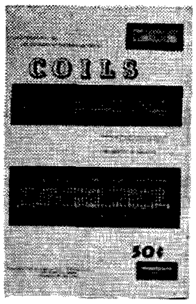


The first five issues of this invaluable bulletin are now in print. Each one is worth more than the year's subscription. Send $2 for complete set from #1 up through #12. Quantity limited so don't wait.

CARE AND FEEDING OF HAM CLUBS $1.00



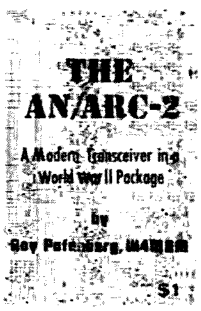
K9AMD's interesting book on all aspects of forming and holding together a ham club. This is the result of exhaustive interviews with many club officers and will be invaluable to every club going.



COILS 50c

Well illustrated basic book which describes all of the different types of coils to be found in radio work. Covers theory and practical aspects.

AN/ARC-2 CONVERSION $1.00



Complete schematics and thorough conversion details on this modern transceiver which covers 2-9 mc (80-40 meters . . . and 160). This unit now sells for $40 to $50 surplus and is easily converted into a terrific little transceiver.

WORLD GLOBE (plus subscription for one year) $16.95

Every visitor to the 73 HQ shack is taken aback by the beautiful world globe next to the operating position. We find this invaluable for figuring out beam angles and planning world tours. It is 18" in diameter, normally sells for $19.95 (via CQ), is nearly five feet around the equator. Canadians please allow a little extra for Diefendollar exchange.

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER THREE NUVISTOR PREAMPLIFIER for perfectionists, complete with self-contained power supply. Kit contains nuvistors, sockets, all condensers, resistors, potentiometers, power transformer, rectifier, switch, antenna coax connector, etc. See article in March 73 page 8. Everything you need, complete with full scale drilling template.
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Kit W1MEL-1 . . . . . $6.00
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ADJUSTABLE REGULATED XSTR P.S. as described page 8 April 73. Five transistors, zener, complete kit of parts. W1ISI-1 . . $25.00

DIODE NOISE GENERATOR P. 15, April 73.
THOMAS-1 . . . . . $9.00

VECTOR VFO (p. 24 April 73)
Complete VFO kit. W7IDF-1 . . . . . $6.50

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SIH—SSB COMMUNICATIONS HANDBOOK—by W6YTH. This book covers all known methods of generating SSB with details on them. Discussion and schematics on many popular SSB rigs. Very educational, and mostly for the ham. **$6.95**

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INDEX TO ADVERTISERS

To aid you in finding ads which are not running in this issue we have listed the last ad run by each company in 73.

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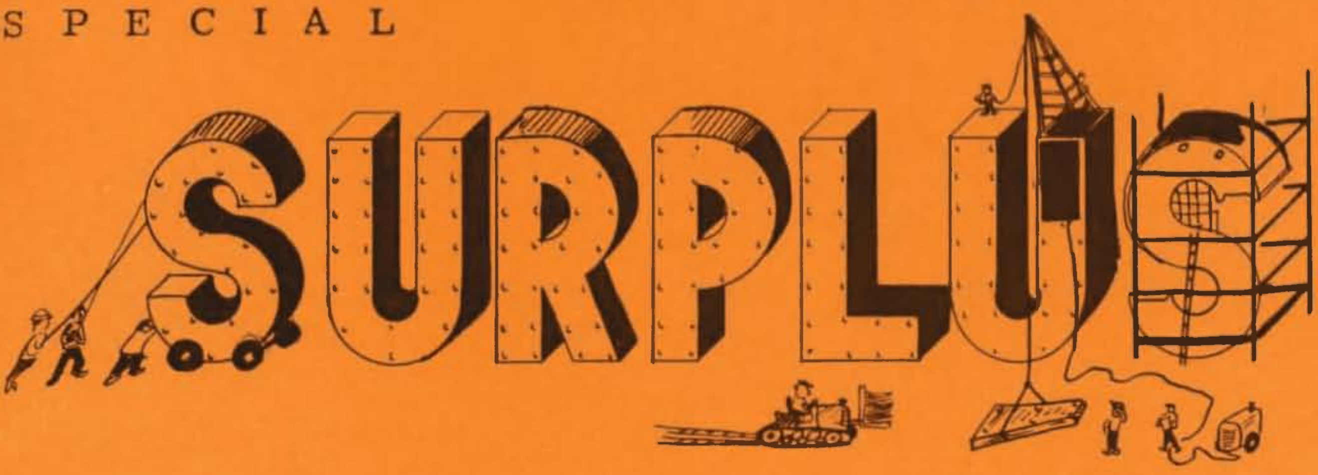
73

JUNE 1963
40¢ Yet!

Amateur Radio

SPECIAL



CATALOG ISSUE

73

Magazine

Wane Green, W2NSD/1
Editor, etcetera

June, 1963

Vol. XIV, No. 6

Cover:
W2NSD/1
drawn by W1MEL

73 Magazine is published monthly by 73, Inc., Peterborough, N. H. The phone number is 603-924-3873. Subscription rates are still abysmally low at $3.50 for one year, $6.50 for two years, and $9.00 for three years in North America and U.S. possessions. Foreign subscriptions are $4.00 per year. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in the U.S.A.

Postmaster: please send form 3579 to 73 Magazine, Peterborough, New Hampshire. We told you last month to stop reading the fine print and stick to the articles and editorial.

FLASH FLASH FLASH FLASH

The FCC has just announced that the license fee for new and renewal amateur licenses will be $4.00 effective Jan. 1st, 1964. Modifications will be $2.00, Novices and Races; no charge. Special calls will be $20 (section 12.81). How about that!

de W2NSD

Never say die

A Sense of History

A fellow called up the other day ranting and raging against the ARRL. He had a number of gripes, the foremost of which was that the Building Fund was a hoax. According to this chap the ARRL had been putting money aside for a number of years toward the costs of the new building. He wanted to know why, if they had over $500,000 set aside for a new building, that they are now trying to coax $250,000 out of the members. I couldn't participate in his sense of outrage since it seemed to me that somewhere in the past the members had been warned that the League did have plenty in the bank to build the building, but that they wanted to preserve this fund for some future rainy day.

His second complaint, though I disagreed with it, set me to thinking. His point was that conventions should be serious affairs whose main purpose is to permit the members to gather together to decide how things are going and make any changes they deem valuable. I'll have to admit that this is a far cry from the conventions that I have attended which have featured prizes, manufacturers displays and a series of talks on ham subjects.

This set me to mulling. I must admit here that the years have increased my annoyance at pomp, ritual and other historical remnants. Though history is interesting, I do not believe that we should be a slave of it. Look what happened to those societies which were not able to cast off the yoke of "this is the way my father did it." This is the cry of ignorance. "It has always been this way."

But yesterday is gone and it deserves no reverence since we are living only today. The question is: how are things today? Are they the way we want them? If not, let's make them the way we want them so that when tomorrow becomes today we will have them the best way. This can be particularized by applying the thought to ham radio. Is ham radio today the best that it can be? Judging from the number of letters of frustration that I receive, I would guess not. Then isn't our best bet to take a critical look at ham radio and figure what improvements might make it better fit the present situation? This is something that could be done at conventions.

Are our bands divided up the best way for the current number and type of operators to get the best use from them? Is it possible to provide incentive for general technical development of amateurs, or is this even desirable? Is the ARRL meeting today's needs? Are our experimentally inclined amateurs too contained by the present rules? Would it be advantageous for the possible development of new techniques to simplify the issuance of experimental permits for stations that are interested in trying out new ideas . . . things come to mind such as slow scan TV, narrow band TV, repeater transmitters for VHF and FM, remote operated rigs, etc.

It wouldn't hurt to update our thinking on other matters such as license requirements, enforcement of rules, contests, certificates, and all of the factors which make our hobby the way it is today. Just think of the impact that the DXCC Certificate has on ham radio! It causes fantastic pileups every time a new country comes on the air and it brings on DXpeditions. There are a number of bulletins just devoted to this phase of the hobby and a couple thousand hams totally submerged in it.

Will we always go along leaving things pretty much the way they are, with many fellows opposing anything new automatically? Or can we perhaps some day establish a system of constant re-evaluation of our present situation so that we can better meet the needs of the present when the future arrives?

(Turn to page 6)

(W2NSD from page 2)

Out For The Buck

Every now and then I run into someone who says, "Come off it Green, you're out after the buck just like everyone else." It is my belief that seeking money, like seeking happiness, does not find you happiness . . . and usually does not find you money either. People out after the buck usually end up outsmarting themselves; I've seen it happen time after time.

Pardon the oleaginous platitude.

In application this means that 73's subscription rates are the lowest that I can make them and still publish the magazine. I am quite confident that our subscription rates could be increased to the $5.00 of CQ and QST without any great loss of readership for we are giving more magazine and the reader comment, with the exception of an occasional nut, consistently insists that 73 is the most read ham magazine and the most interesting. Perhaps I'd better define nut for you: a nut is anyone who wants to cancel his subscription when he reads an article that he disagrees with . . . or am I being too generous?

We could easily raise our advertising rates considerably without suffering any great loss of advertisers for the cost per reader in 73 is so incredibly far below that that the advertisers have to pay elsewhere that we could almost double our rates and still be a bargain. Though our circulation is now well over seven times our original circulation, our ad rates have not yet doubled. What does this gain? Well, it allows those manufacturers of ham gear who have good products and limited budgets to merchandise their equipment at a minimum expense. Take a good look at our ads and you'll see for yourself. We don't have all of the big manufacturers who really don't care much what their advertising costs, but when it comes to the chaps who have to watch their dollars closely in order to stay in business, they are advertising in 73.

One of the best examples of this is mail-order advertising. The mail-order advertiser knows right away which magazines are giving him results because he can't exist without the results. If you take a few minutes and count the pages of mail-order ads in all three magazines you'll find that month after month 73 has more mail-order than both CQ and QST combined.

If we were to raise our ad rates substantially we might get more "prestige" advertising and we certainly would make more money, but we

also would push a few more small ham companies out of business. We're making ends meet here . . . anthors are being well paid upon acceptance of their articles . . . our small staff is getting enough to eke out a living up here in budget-living New Hampshire . . . Virginia and I have yet to take any salary, but we're so immersed in running the magazine that it hasn't made any difference.

Running at no profit, as we are, I can see where over $5,000 a month of our money is going into taxes . . . I hate to think what would happen if we made a profit!

SSB on 160M

The FCC has rescinded its prohibition of SSB in the 160 meter band effective April 15th after checking out the possible QRM to the Loran-A in the adjacent band. That should help things somewhat, though it may give a few commercial equipment manufacturers who have left the 160 band out of their rigs some nervous fits.

In Canada

Canadian amateurs may now order our parts kits. The only catch is that they will have to add 45% extra to cover little government foibles such as the currency difference, import duty and sales tax (8% plus 20% plus 11%, cumulative!).

It occurred to me the other day that I have dedicated my life to ham radio. That shows you how a hobby can get out of hand, eh? The beginning of my publishing career was back in 1951 when I put out the first mimeographed RTTY bulletin. This grew and grew until, through a strange sequence, I found myself editor of CQ in Jan. '55. I hung on there at least two years longer than I should have and finally left in disgust in January 1960. In April I started the groundwork for 73 and the first issue came out in October 1960. And here I am.

I guess mostly I am working at this to provide a magazine that will be fun to read and perhaps make ham radio a little more enjoyable than if I didn't exist. I feel a personal grudge against the few fatherless fellows who have crept into our hobby and want to use it to spread their unpleasant personalities beyond the circle of their families and work.

As Virginia puts it, "Not very many writers get a chance to entertain 75,000 people every month, pretty much on their own terms." That is good, isn't it?

Incentive Licensing

Since the whole subject was brought up in QST entirely for the purpose of creating con-

(Turn to page 118)

Herbert Holtje W2TQS
151 Sunset Lane
Tenafly, New Jersey

Photo by WA2MXT

Instant 220

Using the AN/DMQ-2

Suggesting the use of frequencies above 144 mc to most amateurs today is like campaigning for CB on 10. Most of the resistance (or impedance if you consider the reluctance) comes from the feeling that you have to hold an EE to even tune a 220 rig. It's true that you've got to be a little more careful with lead length and component layout, but if you've ever built anything at all (kits even), a little care is all that is necessary to do an acceptable job on 220.

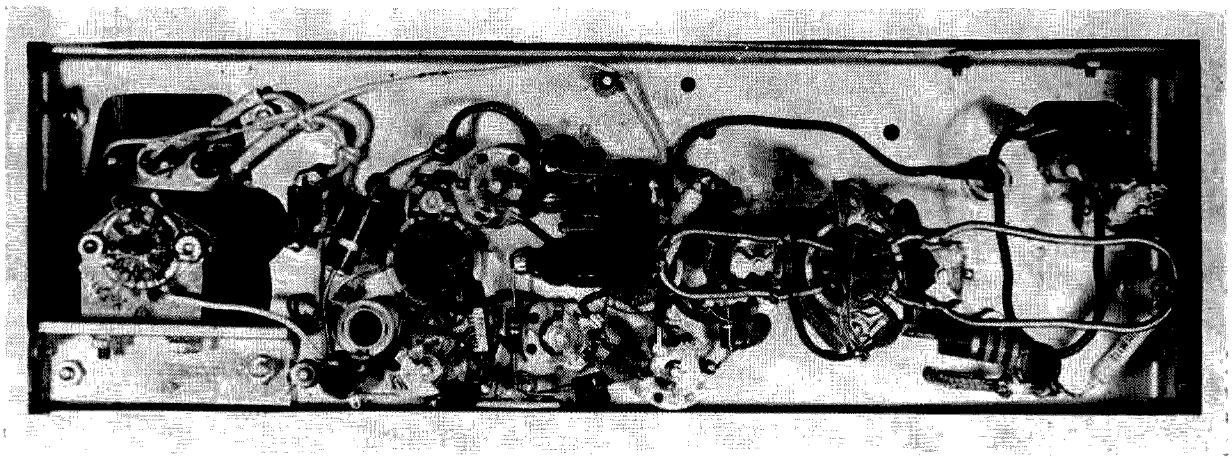
And if you're really interested in these fascinating frequencies, there's a piece of surplus gear available for around fifteen bucks (with tubes) that can be modified in a few hours to put out a very respectable signal for all of its 12 watts input. Barry lists it simply as "VHF Transmitter," and other surplus houses call it the AN/DMQ-2. This rig has been described before in a conversion to two meters, but the conversion to 220 is much simpler.

Originally intended for use at 240 mc, it is only a matter of changing the 60 mc third overtone crystal to a 55 mc rock, eliminating a few parts and squeezing a few coils to get output on 220. There are some refinements (which will be discussed in this article), but it's as simple as that.

Let's go thru the modifications, section at a time. First of all, when you get your rig, it will have a spring loaded antenna which is held in place with heavy twine. When you cut the cord, point the antenna away from you, or you're liable to be the first ham on your block skewered on a whip.

Four bolts hold the gasketed rig in its watertight container. Remove these and slide the rig out. The first step is to get the antenna out of its well and replace it with a standard coax fitting. This is done by cutting the antenna lead, backing off on the knurled retaining nut and sliding the whole assembly out of the rack. When this has been done, run a short #12 tinned lead from the antenna link to the newly installed fitting.

The next step is optional, but I found it



Up-ended view of the converted 220 mc transmitter. Note the amount of compression in the final tank and output loop to put it on 220. The positioning of the added choke in the final grid circuit can be seen to the left of the grid coil. The bracket supporting the VR tube socket is positioned in the space previously occupied by the keying motor. The grid circuit metering jacks are re-mounted above the chassis and can be seen thru the opening next to the VR socket.

much easier to work with a standard Jones plug and socket for the power connections than the bulky military plug that is supplied with each rig. This plug comes off by backing off the nut on the connector shank on the inside cover. To get a Jones plug in, it is necessary to file the round hole square.

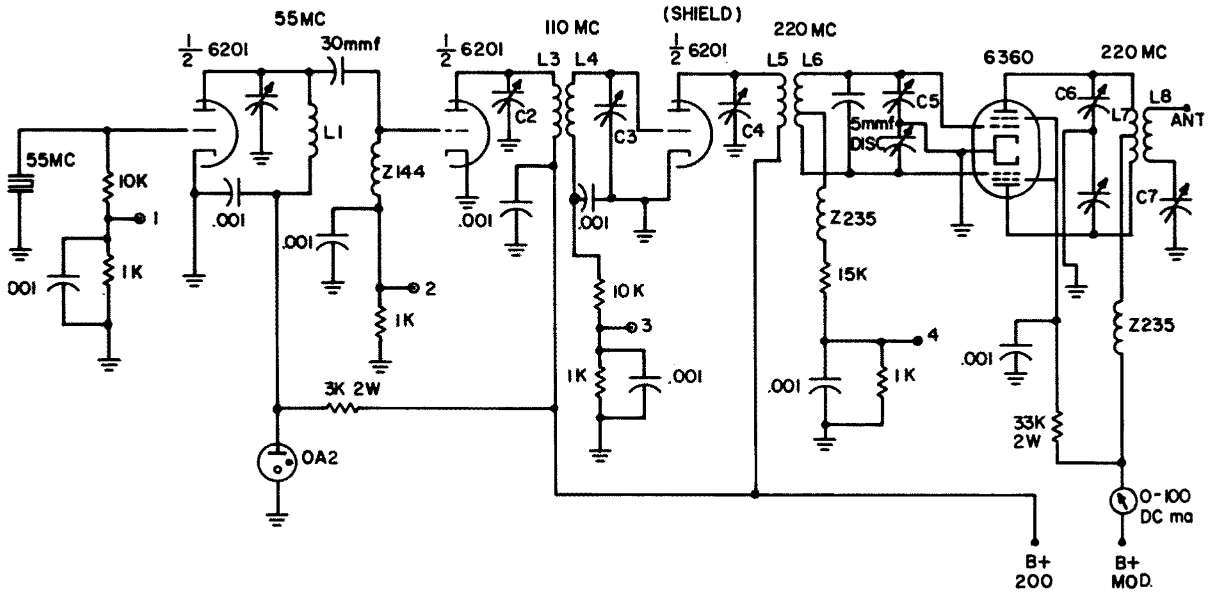
Next, remove the motor keyer on the rear of the chassis. The leads from this are traced to their original and removed. They are: 1) power, 2) keyer control (to the cathode of the tone modulator). While you're fussing with the keyer, remove all wiring to the second half of the second 6201 and ground the unused grid, plate, and cathode. In removing this wiring, you will remove a transformer, 2 resistors to pin 8, a resistor and capacitor to pin 7 and a resistor and capacitor to pin 6. Discard these components (unless you're like me and collect things because someday you might find a use for them—spark gaps, etc.). These components make up the tone modulating circuit. Lift the lead from the screens of the 6360 and make the final amplifier modifications as shown on the diagram. The final plate and screen are now wired for modulation and can be operated with any modulator delivering from 6 to 10 watts, depending on power input. Don't run the 6360 any higher than 20 watts input.

The oscillator is very simple to change. All that's necessary is to eliminate the coil in the cathode circuit and ground the cathode. The feedback capacitor on the plate coil center tap is removed and the oscillator is ready to go with a 55 mc rock. The voltage regulator brings the plate voltage to a safe point for the overtone crystal and reduces the instability found in overtone oscillator circuits.

The only changes required in the two doubler stages are to squeeze the coils and adjust the capacitors to resonate at 220. Use a grid dipper here.

The grid circuit of the final was the stickiest problem, in that the drive was marginal. This was solved simply by adding one of the Z235 chokes, taken from the final wiring, to the 15K grid resistor and adding a 5 mmfd disc capacitor across the 6360 grid tuning capacitor. Shielding the driver then brings the drive to the point where there's enough to spare. My rig runs a mil and a quarter, but it has run well with only one mil.

That's it in a very small nutshell. Tuning is simple and straightforward. Pin jacks are already provided in each grid circuit. Tune each for maximum. Tuning the final is done most accurately by using both the plate meter and a field strength meter. The point of maximum output does not occur at the lowest point in plate current dip, so it is better to rely on the field strength meter for the point maximum output. Actual loading of an antenna is, of



L_1, L_2, L_3, L_4 can be resonated by adjusting capacitor (Use GDO)
L_5, L_6 should be brought close together and resonated with capacitor (Use GDO)
L_7, L_8 should be squeezed and resonated with capacitor (Use GDO)
By adding Z235 choke in grid return, placing 5mmf across final grid coil, and shielding the multiplier/driver tube, enough drive is available for 6360
Check all grids for maximum
Adjust final for dip on plate meter, and max output on field strength meter
Ground unused elements in 2nd multiplier

course, accomplished by dipping and loading with the link capacitor.

How does it work? Using a 12 element colinear array from an average VHF location, I work 20 to 30 miles each evening with the regular crowd on 220 in northern New Jersey, and when conditions are right, distances of 80 to 100 miles have been covered with S7 to S9 reports. I haven't had the chance to put this rig to the rest during a really bang-up opening, but judging from these results, I'm sure that it will be in there with the best of them.

There are other ways to modify this rig for 220, and one of the more popular approaches around here has been to completely modify the oscillator and multipliers so that 8 mc crystals can be used. I have not done this, but it does have several important advantages. The most important of these are: 1) 8 mc rock are less expensive than 55 mc overtone crystals, 2) a higher degree of stability is obtainable than with overtone oscillators (for you purists).

That's it. Now that you've got your 220 rigs going, I'm looking for some over-the-horizon skeds to W1, W3 and W4. A note of thanks is in order here to K2HGH, K2DIG and W2BPU for their help and on-the-air reports during the "I-think-I-should-go-back-to-stamp-collecting period."

. . . W2TQS

More Selectivity for the RT-91/ARC-2 Transceiver

Gilbert de la Laing W6BJI

An article appearing recently in 73 Magazine[1] described the RT-91/ARC-2 transceiver together with a method of conversion to ac power. This transceiver makes a very convenient means for covering the many MARS frequencies plus coverage of the 80 and 40 meter bands. The ability to have transmitter and receiver tuned to 8 spot frequencies and loaded correctly to the antenna through the Autotune feature is worth the price of the equipment many times over.

There is one area in the receiver, however, that needs improving. The selectivity leaves much to be desired in the crowded ham bands and affords little protection from signals adjacent to the MARS channels.

This article is intended to offer one means of obtaining a vast improvement in selectivity with a very small outlay for parts. Less than 2 dollars should provide the necessary parts.

Obtaining the desired improvement in selectivity through conversion of the *if* signal to a lower frequency as in the "Q-Fiver" selectivity scheme is impractical. The "Q-Multiplier" approach is equally impractical due to the fact that the *if* frequency is not fixed but varies from 1 to 1.5 mc, being gang-tuned along with the PTO, multipliers, rf and mixer stages.

Adding controllable regeneration to the first and second *if* stages and reducing the coupling between the *if* stages provides a means of obtaining a worthwhile improvement in selectivity. To effect these changes, change C-201, C-210, and C-219 from 5 mmfd each to 3 mmfd each. These capacitors can be found under the *if* shield cans located near V-109, the 12SA7 mixer tube. Now add a "gimmick," two short lengths of insulated wire 1 inch long twisted together to form a small capacitor, between plate (pin 8) and grid (pin 4) of the V-110 socket. Increase or decrease the capacity of the gimmick until the *if* stage nears the threshold of oscillation. Add a similar gimmick between plate and grid connections on the V-111 socket and adjust similarly. Remove the "L.F. REC./NORMAL" switch on the front panel and install a 2,500 ohm potentiometer. Connect the potentiometer in place of R-139, the cathode bias resistor for V-110. This control will then serve to control regeneration in the *if* strip.

The movable *if* slung should then be peaked. These are marked D1, D2, D3, D4, E1, F1. Peaking the *if* transformers may cause oscillation in the *if* strip and require a reduction in the capacity of the gimmicks.

These changes should result in 10 kc or better selectivity. . . . W6BJI

1 Pafenberg, R. The AN/ARC-2, 73, Vol. XI, No. 1, October 1962, 82.

PARTS LIST

C-201, C-210, C-219—3 mmfd tubular ceramic capacitors.
R-139—2,500 ohm potentiometer.

PE-97A? What's that?

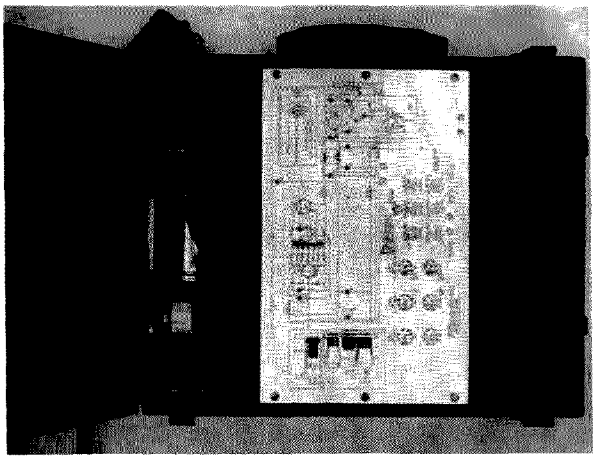
or . . . 12 in, 250 out

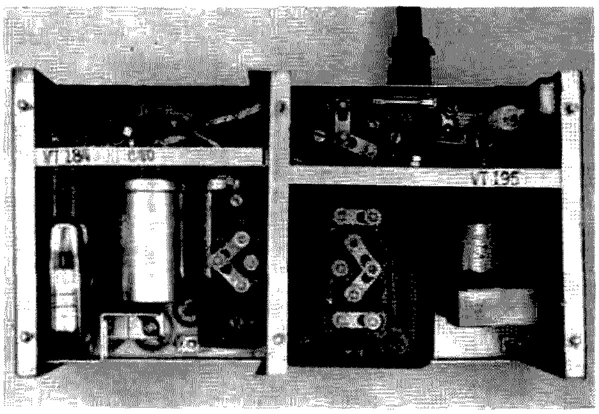
Blackie Blackburn W4DWU
2620 N. Brandywine St.
Arlington 7, Va.

Power supplies may not be too exotic a subject, but every mobile needs one or more. The unit described here gives 250 volts dc at 100 ma or better with 12 volt/3.5 amp dc input, just right for a Heath TWOER or similar rig. Conversion of the PE-97-A (or the similar PE-120-A) yields a highly rugged but compact mobile supply whose husky military components are not often found in amateur gear.

This is one of the easiest surplus conversions you can make, despite the fact that the PE-97-A as received from your friendly surplus dealer appears to be a totally unlikely prospect of ever amounting to anything. In the first place the output voltages are all wrong for most uses, being 125 volts dc and 75 volts dc under transmitting load, along with 1.4 vdc for filaments. In the second place, it is a little large to tuck away nicely in various corners of a car. Boosting the output to a more useful 250 volts dc is covered below, while the size problem is taken care of by extracting the basic power pack from its somewhat out-sized case.

A very simple electrical conversion to provide 250 volts dc output instead of 125 volts is possible because the power supply contains three terminal boards with links which were originally provided to permit setting up for either 6 or 12 volt battery input. What we are going to do is operate only on 12 volts dc input, but set the links on the transformer





primary terminal board for *6 volt* operation—thus giving us just twice the original secondary voltage and a resultant 250 volts dc output at 100 ma. Sneaky, huh? This is quite permissible since components are conservatively rated, including the filter capacitors which are 400 wvdc.

Per the schematic of Fig. 1, terminal board "A" is set for 6 volts input. At terminal board "B" the .4 ohm resistor is strapped out (link between 13 and 14); also at "B", the 20 ohm resistor R3 is left in the circuit to drop 12 volts to 6 for the vibrator coil (no link between 13 and 15). Ignore terminal board "C".

Since the 6.3 volt rectifier tube filaments are run from another winding on the same power transformer, this became 12 volts when we doubled the plate voltage. There are several ways out of this little box, the simplest being to place a filament dropping resistor in series with the lead from the filament winding on the transformer to pin 8 of rectifier tube VT-195 (RMA type CK-1005). A 56 or 62 ohm 2 watt resistor would serve. However, the CK-1005 is the one component not conservatively rated and replacements are not easy to find. Another approach is to replace the 6 volt CK-1005 with a 12 volt tube such as a 12X4, but this would entail more extensive rewiring and a socket

change (i.e., work) and is to be avoided at all costs.

The solution used here was to take the base from an octal tube and mount surplus silicon diodes in same. This can be plugged directly into the CK-1005 socket, burns up no power in dropping resistors or filaments and provides a good margin of safety for handling the higher plate voltage and for pulling a little extra plate current if need be. Four diodes are used in series in each leg; unfortunately, these diodes are so surplus that they cannot be identified—but they have sufficient margin in rating so that protective resistors or capacitors across each diode are not required. Barry Electronics has 600 piv/750 ma diodes for 36 cents each. Two such diodes should suffice for each leg if protected with a 500K resistor (or .01 mfd capacitor) across each diode, as shown in Fig. 2. Here again, a good scrounge artist will find ways to make do.

Electrically, that's about all there is to it. In order to hold things down under no-load conditions, the regulator tube VT-184 (VR-90) was replaced with a VR-150 and resistor R7 increased to 5,000 ohms. A 10,000 ohm resistor could have been used just as well in place of this combination—the objective being to put about a 30 ma load on the supply before filaments are warm in the rig. Regarding terminal board "C", do not try to pick off your 12 volts for transmitter or receiver filaments from socket 3 with the idea of getting filtered filament voltage through the CH3 network. The original designers were very crafty here and used the 7 ohm dc resistance of filament choke CH3 to take 6 volts down to 1.4. This sort of thing we can do without; either take filament voltage directly from the battery, or set ter-

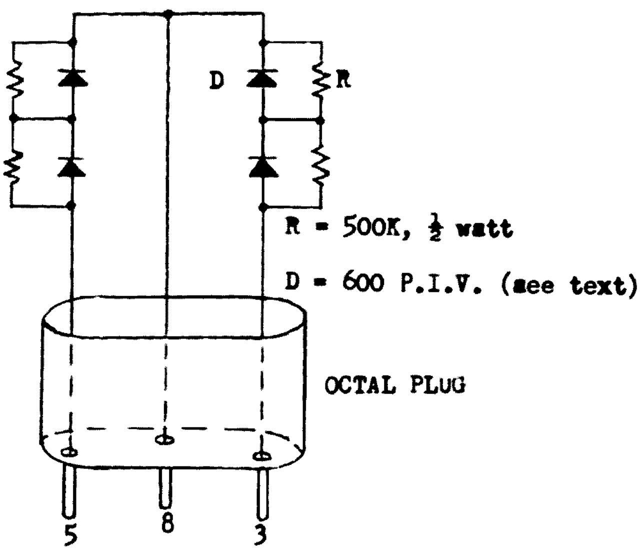
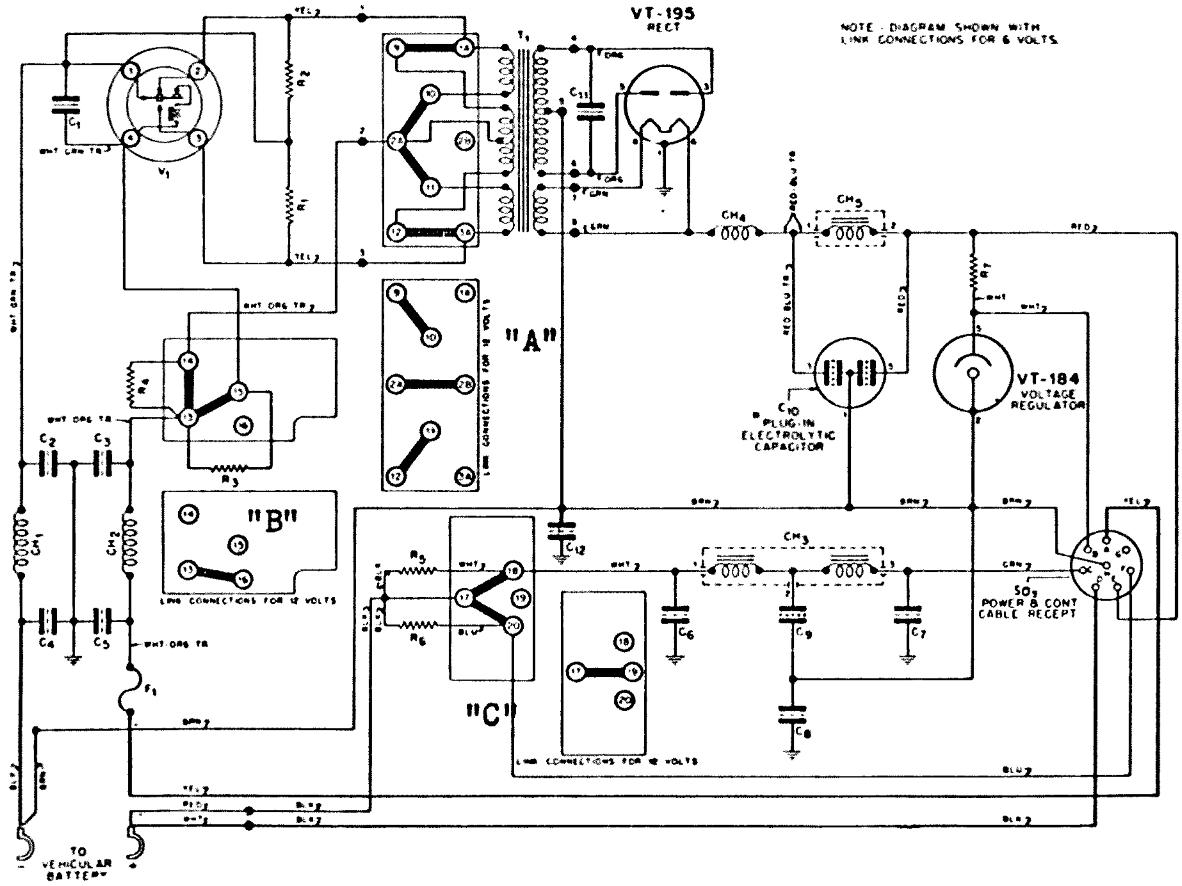


Fig. 2



minal board "C" to the 6 volt or straight-through position and short CH3 out. By keeping your filament leads completely out of the vibrator box no filtering is required in most applications, the TWOER being one such.

The only mechanical problem of any proportion is in saving the 10-foot battery cables when removing the basic power unit from its outer container. The rubber seals through which the cables run *can* be removed with a little surgery, and you will wind up with some nice heavy cables still hooked directly to the power unit. Various ways can be devised to lash the supply up to available equipment. By jumpering the input plus 12 volt cable directly to fuse F1 in the case, a remote on-off switch can be placed in either the plus or minus 12 volt battery cable. A spare wire in the cable was used to take plus 250 out.

In casting around for a PE-97-A you may encounter a very similar unit, the PE-120-A. The former is to be preferred since components are more accessible. The PE-120-A uses a rather weird system of special plug-in vibrators for each input voltage (6, 12 or 24) which make the correct transformer primary connections, instead of by terminal board connections as in the PE-97-A. Either use a 6 volt vibrator and add a 20 ohm resistor in series with the vibrator coil (pin 4) as done with the PE-120-A, or use a 12 volt vibrator and shift primary connections at the transformer terminals. Circuit tracing is facilitated by the large schematic printed on the metal cover of the unit. One word of caution: the PE-120-A appears to use 200 wvdc filter capacitors; if this is the case, either replace them or use the unit for a boat anchor.

Vibrators of 1944 vintage may have become inoperative during storage due to oxidation of the contacts. Before concluding that a replacement is required, try giving the vibrator a few good healthy whacks when first energized. If this doesn't work, a seemingly dead vibrator can sometimes be brought back to life by applying ac voltage from a filament transformer to the vibrator coil pins instead of dc.

The PE-97-A is available from various surplus sources and MARS programs; it powers the BC-620-A, part of the SCR-510-A. Unless the price is right, say zero to eight dollars, forget the whole thing—you can buy a new supply to do the same job for $25 or so, although not of such rugged "Mil Spec" construction. A peek at the innards of the PE-97-A will quickly convince you that here is real quality, well-worth putting to use. . . . W4DWU

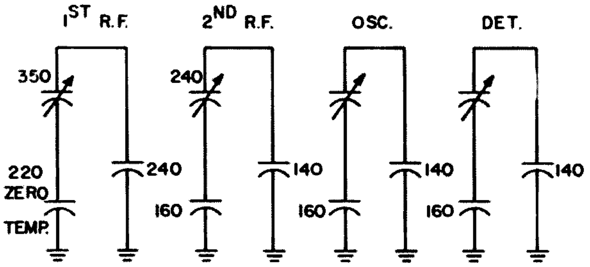
Band Spreading the BC-348

Albert Hankinson W5EUL
5409 South Drexel
Oklahoma City 19, Oklahoma

Back in 1947, I squandered about thirty dollars on a BC-348. After a year or so of ownership, I was thoroughly convinced that I needed something of a slightly higher caliber, to say the least. This was postponed due to the type of work at the time which involved travel and which continued until 1955. The end of the travel in 1955 was complicated by marriage so I still had the 348 with added expenses and lowered funds involved.

During this time, I periodically pulled the 348 up on the bench and added and subtracted wires, tubes, parts, knobs, and FL-8 filters. I tried improving the crystal filter, added an outboard Q5er, in addition to another audio stage, all with a measure of success, however slight. For one reason or another, each time I have restored the receiver to "nearly" its original condition. "Nearly" meaning, the rf and af gain controls are still split, and the front end has been converted to 717's instead of the original 6SK7's, and the addition of a noise limiter.

Through all this time, the same basic problem has existed, rotten selectivity! The outboard Q5er alleviated this problem but in itself contributed others, mainly being outboard and having a poor audio system. This in itself is fairly easy to remedy by using any one of many ways of converting the 915 kc *if* to a lower frequency, preferably 85 kc. However, what seemed to be a stumbling block, was the pitifully small space on the dial alloted to the amateur bands. This was particularly annoying when one considered the vast amount of dial not being employed for any gainful use.



Note: Fixed capacitors should be zero-temp types if possible.

This called for circuit analysis and possible surgery! Upon examining the schematic, in conjunction with a bird's-eye view of the receiver, it was noted that with no great difficulty, one could get at the leads on top of the main variable. The view shows immediately that the section associated with the 1st rf stage is larger than the other three sections. According to the Tech manual, the large section is 350 mmfd, while the other three are 240 mmfd. Under the urging of W5NTL, I decided to try basic surgery which seemed logical, and spread the amateur bands over a much larger area.

The main thing about this modification is that it worked and that it was accomplished at a cost of approximately $2.00. There are advantages and disadvantages to this modification which are left to the individual. I think the advantages outweigh the disadvantages, in addition, a little additional work on the receiver would possibly eliminate most of the disadvantages.

Fig. 1 just about tells the entire story of the basic modification.

With reference to Fig. 1, note that the lead to the coil box from the tuning capacitor has been opened and a 220 mmfd capacitor inserted. (This is with reference to the 1st rf stage.) This series capacity reduces the total capacity for this leg to less than 220 mmfd. The same thing is done in the 2nd rf, oscillator and detector stages. In the latter stages, the value of the series capacitor is 140 mmfd. What has been accomplished here is to keep the new total capacity in the proper proportion. This is important in order to maintain our basic tracking. Reducing the total capacity by itself would merely cause our bands to drop to lower dial readings on the receiver so a further step is required. By adding a capacitor in parallel with the series combination, we

restore the total capacity to its original value. (Or close thereto.) Now, when we start spinning our tuning control, the rate of change per turn of the control has been greatly reduced.

On completion of this part of the modification, things started to look much brighter. On the 3.5 to 6 mc band, the low end of the dial was found to be 3550 kc while the top of the band (4000kc) was 5.575 on the dial. This means that approximately 450 kc of the band is now spread over 2000 kcs on the original dial. This is better than four times the original and is certainly not hard to take.

On twenty, 14 mc was found at 15.5 on the dial while 14350 was at 17. Again, the improvement was more than 4 times the original. On forty, and here panic set it! Frantic spinning of the dial revealed *no* forty meter band. Everything seemed black! Finally I combed the 6 to 9.5 band and found that 9.5 mc (dial) corresponded to a frequency of approximately 6875 kc. On examining the schematic, it was found that small padders were in the circuit associated with Band 4 (6 to 9.5). These capacitors are listed as Part #31 (160 mmfd), #38 (85 mmfd), #39-1 (81 mmfd) and #35-1 (95 mmfd). By opening the tops of the coil sections, these capacitors can be identified by locating the trimmer for Band 4 and lifting the capacitor which is tied to one end of the trimmer.

This is not difficult to locate as these trimmers are dual ceramic trimmers and one end of each is tied to a common lead. On lifting these four capacitors, I found my precious forty meters now appeared between 6.4 and 7.35 on the dial, or the 300 kc of forty were now spread out over 950 kc on the dial.

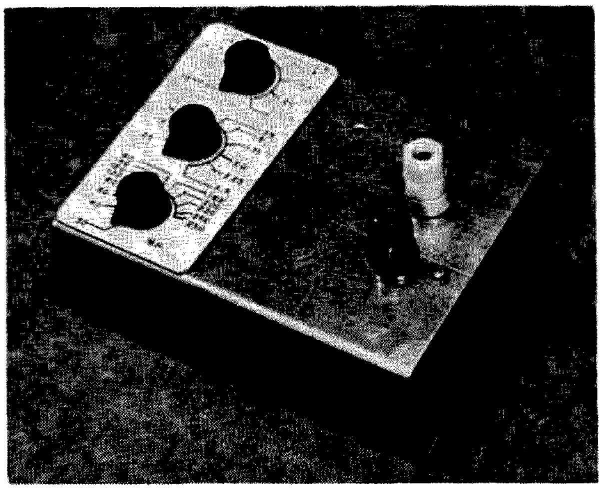
Unfortunately, 160 meters has almost completely vanished. A little more work may restore this by using the same procedure applied to Band 4.

It is necessary to obtain the services of a frequency standard in spotting the bands. As a final step, you could remove the front plate and make up a new dial plate. If one takes the trouble to dig back through the past years of technical magazines, there are many other worthwhile modifications that can transform this venerable veteran into something other than a good boat anchor.

One small note, I could not obtain 140 mmfd capacitors at my local source of supply so I temporarily substituted 130 mmfd which work just fine. I estimate that to return the 348 to its original condition would require about 15 minutes maximum. Have fun!!

. . . W5EUL

The Lazy Man's Coil Evaluator



Parts Kit Available

David Yeoman WOQWY
RR #1
Toddville, Iowa

When WØLFH asked if I know a simple way to check audio coil inductance, I had to give him a no. I no sooner got home than I found the November issue of 73 with an article entitled "Choke Evaluator." [1] At first I thought this was the answer to Si's problem, but after reading the article, I wasn't so sure. The mention of: 1, having brains, 2, square roots, and 3, ten minutes calculation time didn't appeal to me.

Now I'm not much of an originator. I seldom have an original idea, but give me an inspiration and I'm bound to come up with a modification. Thus armed with the inspiration and a lazy streak, I set off to design the "Lazy Man's Coil Evaluator."

Theory of Operation

For those interested in such things, a few mathematical gymnastics will serve to justify this approach to coil checking. Consider Fig. 1, a simple series circuit. In such a circuit, the current is the same in all parts, and is determined by Ohms law for ac circuits, $I=E/Z$. E is the source voltage, and Z is the impedance

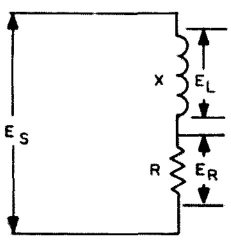


Fig. 1

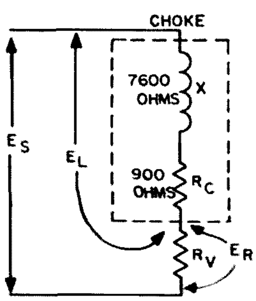


Fig. 2

of the circuit. Someone else decided that $Z=\sqrt{R^2+X^2}$. R is the resistance in the circuit and X is the reactance, ($2\pi fL$ for coils).

If we were to calculate the voltage across the coil, we would use the above current and the first formula juggled around for voltage, EIZ. For a perfect coil, this reduces to $E=IX$, since there is no resistance included. The voltage across the resistor is $E=IR$.

From above, since the current is the same in both the coil and resistor, if we make the resistor equal to the reactance of the coil, we see that both voltages will be equal.

This is the basis for the tester. We put a variable resistor in series with the coil, connect the combination to a voltage source, and adjust the resistance value until the voltage across each element is the same. The resistance is then equal to the reactance of the coil. This resistance is used to calculate the coil inductance from $L=R/6.28f$.[2] Easier yet, we can calibrate the variable resistor to read directly in inductance (if we use a single test frequency).

"But wait," you say, "we can't buy a perfect coil. They all have resistance in them." I agree, so let's determine how much error this causes.

Consider the filter choke mentioned in the "Choke Evaluator" article. It was a 20 henry choke with 900 ohms coil resistance. For this coil the reactance is about 7600 ohms at 60

[1] Ives, Ronald. **Choke Evaluator,** *73,* November 1962, p *72.*
[2] Since $X_L=2\pi fL$, $L=X/2\pi f$. We have set $R_V=X_L$, thus $L=R_V/2\pi f$, $2\pi=6.28$.

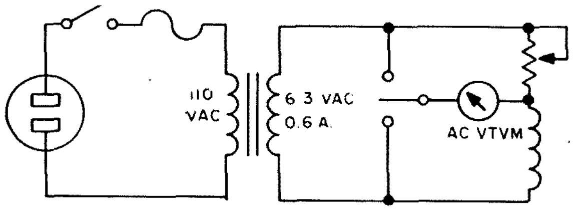


FIG 3

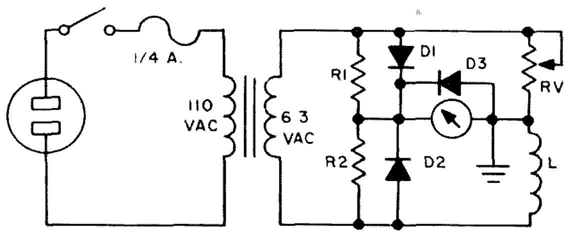


FIG 4

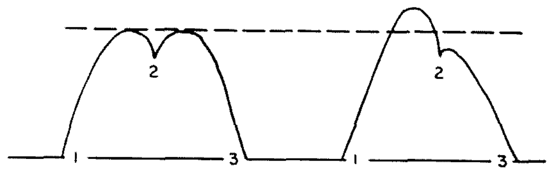


FIG 5

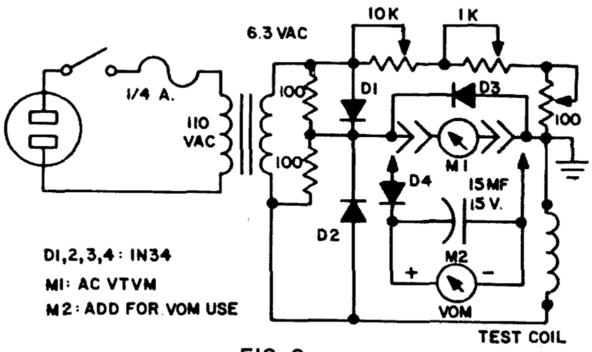


FIG 6

cycles. Now we have the circuit in Fig. 2. Since we can't separate the resistance from the reactance in the coil, we will have to be content to measure the voltage across the combination, or impedance instead of the reactance alone as was originally described. Since $Z = \sqrt{R^2 + X^2}$, the impedance of this coil is $\sqrt{900^2 + 7600^2}$ or about 7650 ohms. Compared to the reactance of 7600, this is an error of only 0.65%, not even noticeable. For a coil with a Q of only 5, (the coil above has 8.4) the error is only 2%. Considering the accuracy to which we can measure our variable resistance, we can forget any resistance in the coil for practical purposes.

The circuit in Fig. 3 was my first idea. The push button is used to switch the meter across either the coil or resistor.

Then the old lazy streak set in again. Gosh it's a strain to push that button. Arrive Fig. 4.

When they see the circuit, most people say, "Aha, a bridge." "Not so," sez I. "It's an electronic push button." Picture it this way. At some time, the voltage at the top of the transformer is positive with respect to the bottom. To diode D1, this looks like forward bias through R2. Current thus flows through this path, and most of the resulting voltage appears across R2. We can then consider the junction, and hence the hot meter lead effectively connected to the top of the resistor, R_V. Slightly later, during the second half of the line cycle, the condition is reversed and the meter is connected across the coil.

The voltage the meter "sees" is depicted in Fig. 5. When both resistance and reactance are 1, equal, the voltage waveform is shown in 5A. The resistor voltage is from 1 to 2. At 2, the transformer voltage reverses and the meter is connected across the coil. It now sees the voltage, Fig. 5A, 2 to 3. If the resistance were greater than the coil reactance, the voltage waveform would be as in Fig. 5B. If the reactance were greater than the resistance, voltage 2 to 3 would be the greater. In either case, the peak voltage is greater than when the two voltages are equal. This results in a pronounced meter dip when the two are equal.

Now all we have to do is turn the pot until the meter dips to a minimum, and we have it all set. Diode D3 clamps the negative voltage excursions to zero, makes the dip deeper and also does away with effects of the change of current phase when changing the pot.

The final circuit is shown in Fig. 6. It is the same as Fig. 4 except that 3 pots are used instead of 1. This allows more accurate calibration and ease of reading. No particular care need be exercised during construction. The original was a ball of wire on the bench and it worked fine.

Although 1N34 diodes are shown, just about any diodes will work providing D1 and D2 are the same type.

If a VOM is to be used in place of a VTVM, the circuit in Fig. 6 should be added. The meter should then be used on a dc voltage scale. The dip isn't quite as sharp as when using a VTVM but the results are satisfactory.

Calibration Procedure

Calibration is simple. The only test equipment required is an ohmmeter. With the tester disconnected from the powerline, and no coil connected, connect the ohmmeter from ground to the transformer lead going to the pots. Turn all the pots to minimum resistance. The resistance you now read determines the minimum inductance that can be measured. Use the formula L=R/377 to determine this induct-

ance, and mark it opposite the pointer of the 100 ohm pot.[3] R is the resistance read on the ohmmeter.

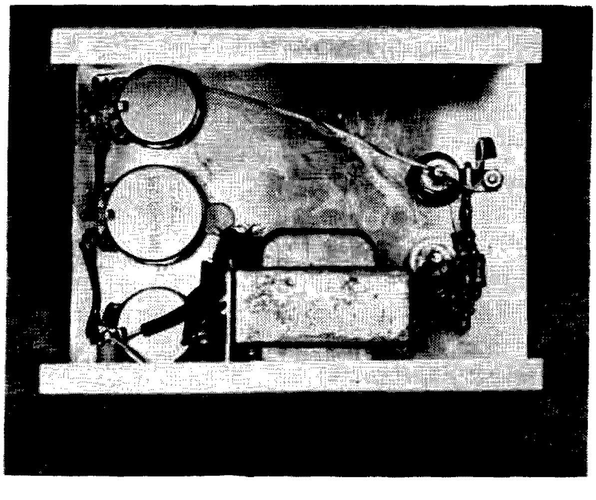
Turning the 100 ohm pot, make calibration marks for the points listed in the chart, and return it to minimum resistance. Repeat with the 1K pot for its points. Finally with the 100 and 1K pots at minimum, mark the 10K pot at its points. After these points are marked, transfer the appropriate inductance values from the chart to the marks on the test set. This finishes the calibration.

To use the tester, first turn all the pots to the *maximum* position. Connect the coil to the terminals, the VTVM to the meter terminals, and turn on the power. Starting with the 10K pot, turn it down until a dip is found on the meter. When it is, turn the 10K back to the next higher mark. Do likewise with the 1K and 100 ohm pots, leaving the 100 ohm in place when the dip is reached. The inductance of the coil is the sum of the values read on the dials. For example, a 16.2 henry choke would read 15 on the 10K pot, 1 on the 1K and 0.2 on the 100 ohm. If a coil is smaller than the values covered by a pot, no dip will be found with that pot, and it should be turned to the minimum resistance position, and proceed as usual with the remaining pots.

Although not designed with this in mind, the evaluator may be used to measure capacitor values. As shown the range is limited to those only larger than 0.25 mfd, but a 1 meg pot in series with the 3 shown will extend the range to 0.003 (at 60 cycles). A Shure Reactance Rule is a convenient method of evaluating the capacitance. The same theory applies in this application.

This little tester is not a precision instrument but it is capable of being a big help when trying to identify that strange mass of wire you just dragged from the junk box. With care in the calibration procedure your answers should be within about 5% of the actual value. For reactances below the range of the tester, the same principle can be applied using a higher test frequency. . . . WØQWY

[3] $2\pi f = 377$ when $f = 60$.



60 CYCLE CALIBRATION POINTS

	Resistance (ohms)	Inductance
100 ohm pot	7.6	20.0 mh
	15.2	40.0
	23	60.0
	30.5	80.0
	38	100
	45.5	120
	53	140
	61	160
	68.5	180
	76	200
	83.5	220
	91	240
	95	250
	99	260
1K pot	95	.250 Henries
	190	.50
	285	.75
	380	1.00
	475	1.25
	570	1.50
	665	1.75
	760	2.00
	855	2.25
	950	2.50
10K pot	950	2.5
	1900	5.0
	2850	7.5
	3800	10.0
	4750	12.5
	5700	15.0
	6650	17.5
	7600	20.0
	8550	22.5
	9500	25.0

Letters

Dear Wayne:

Just a confirmation that Joe Williams, W6SFM, was right when he thought his GG preamp (P40 73 Mar. 63) would work all right on two meters. I made one up as a plug-in to go ahead of the receiver in my Comm. II, using the Fig. 2B input circuit and shunt output to avoid modifying the receiver, and robbing the power from the receiver plug. The Gonset had been changed to use a 6BZ8 RF amp, so gain was available, but now when I plug in the antenna, the noise comes up, which indicates, I believe, a limiting point on noise figure. Also, K1USU, cross-polarized and on the far side of the ridge, who was unreadable previously, except for occasional words, is now weak but solid even on the ground-plane.

. . . **Joel S. Look W1KCR**

Converting the BC-230

Carl Drumeller W5EHC
5824 North West 58th Street
Oklahoma City 22, Oklahoma

One piece of war surplus gear that has been sadly neglected by the amateur is the BC-230 or BC-430, the latter differing only in being for 24-volt supply instead of 12-volt. These little transmitters still may be obtained from surplus houses for from $3.50 up. They are complete with modulator, and, with available plug-in coil units, they cover a range from 2.5 to 7.5 mc. This range readily may be extended to cover from 1.8 to 29.7 mc.

The author has converted a number of these units and has supplied conversion information to many other amateurs. It is his belief that the BC-230 offers much greater ease in conversion as well as much greater versatility than some of the more popular surplus gear. The purpose of this article is to give a brief description of three of the many possible conversions. Each has been thoroughly tested in extended use and found to be quite satisfactory for either mobile or fixed operation.

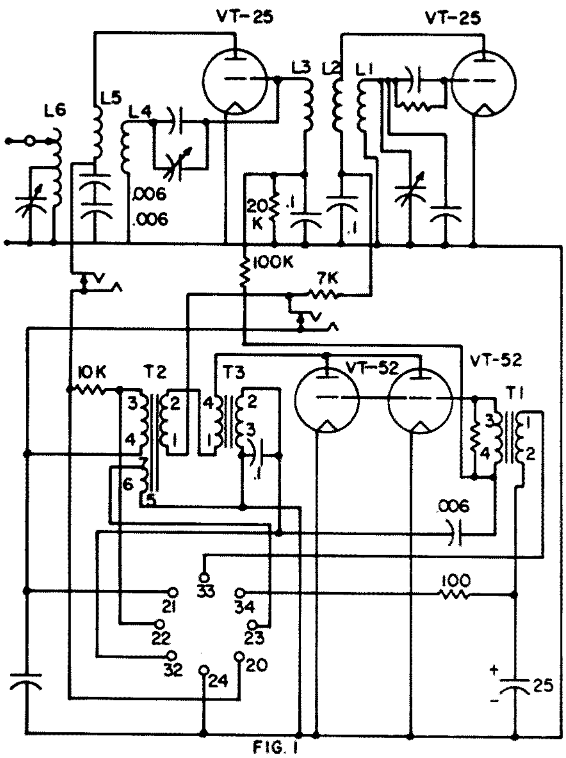


FIG. 1

Original circuit of BC-230

As it is sold, the BC-230 has several components that will not be used and which should be discarded initially. These are the two VT-25 tubes, the two VT-52 tubes, their four sockets, the antenna ammeter, and the side-tone transformer (a black cylinder, located just back of the plug-in coil set). Unless one is fortunate to obtain the female plug to match the power input jack, it is best to replace the jack with another type of connector. An octal socket serves well, although best safety practices indicate the use of a male chassis connector.

Before starting any conversion work, it is well to consider the original wiring diagram, as shown in Fig. 1. In this diagram, T_3 is the tone transformer to be discarded. The 25 mfd capacitor usually is defective and should be replaced initially. Most of the remaining parts will be utilized and should not be removed. The major items requiring change are:

1. The plate tank circuit
2. The modulator bias circuit
3. The tube sockets
4. The heater circuit connections
5. The power connector.

Starting with the first of these, dismantle the 3.9 mc coil set so as to have ready access to the unshielded coil. Unwind the fine wire wound between turns of the heavy wire, then remove the small coil from inside the main coil form; it is easily broken and taken out in pieces. Next unsolder the tap about two-thirds up the coil and move it up to the extreme end of the coil; this will require a longer piece of heavy wire. The full inductance of L_6 now may

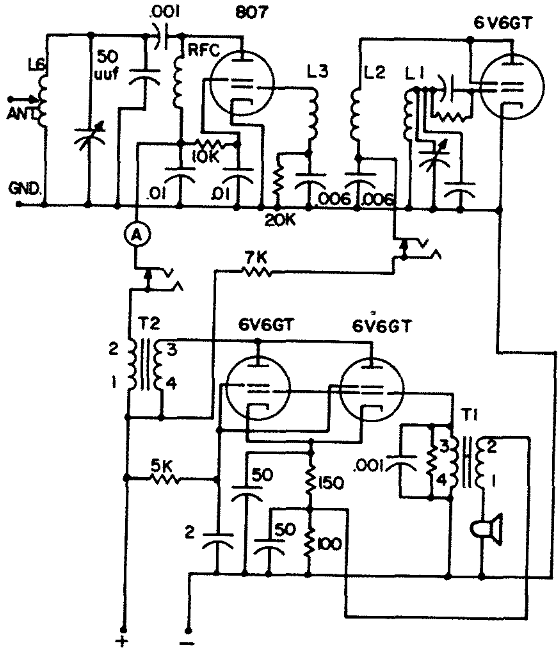


FIG. 2
Simple conversion

be tuned. To resonate without a short, capacitive antenna, however, additional capacitance will be required; so a 50 mmfd, 2500-volt fixed capacitor should be soldered across the whole coil. This is all the conversion needed for the coil set; L_1, L_2, and L_3 are left undisturbed.

Before performing the second enumerated item, it is best to accomplish steps 3, 4, and 5. Replace the four-prong sockets with octal ones, excepting the first one from the front of the set, which should be a five-prong socket for the 807. This socket will have to be dropped about a quarter of an inch to permit clearance for the plate cap of the 807. Wire all the heaters in parallel, and wire in the new power connector. Now you are ready to refer to Fig. 2 for one of the possible new circuits, this being perhaps the most simple.

Starting again with the rf end and working back toward the modulator, the first move is to change over to parallel feed, using a 2.5 mh rf choke and a .001 mfd, 2500-volt capacitor. If you are trustful, you could use the two .006 mfd capacitors for the plate and the screen grid by-pass capacitors, but a higher voltage rating is advisable.

One can either replace the antenna meter with a "two-inch" zero to 100 ma meter or convert the original meter to one by removing the thermocouple, supplying a new scale, and shunting the sensitive movement to 100 ma full-scale deflection. It is strongly urged that one does not attempt to tune the revised transmitter by antenna current.

Having discarded T_3, T_2 is wired in as indicated by the diagram. The resistor labelled 5K may require a bit of experimental juggling of values. The value given worked well for a plate supply voltage of 300 but had to be revised upward to take care of the 475-volt output of a PE-103 dynamotor when used for mobile work.

The microphone secondary circuit is left intact and has a .001 mfd capacitor added across the loading resistor to discourage rf feedback. If there is af feedback, swap over the 1 and 2 connections on the primary.

Note that only a portion of the cathode bias voltage is used on the microphone and that both sections of the bias resistor are by-passed. The capacitors used were 50 mfd each, but any size from 25 mfd up should work well. The screen grid by-pass was 2 mfd, but here again size is not critical.

The tune-up of the revised transmitter is very simple. With an open plug inserted into the PA jack, tune the oscillator with the thumb wheel near the center of the front panel; check the frequency with a receiver, grid-dip meter, or other frequency-measuring device. When on the desired frequency, remove the open plug and rotate the small knob on the extreme left of the panel for plate resonance as indicated by minimum plate current. The degree of plate loading is regulated by the setting of the slider on the plate tank coil. Usually it requires very few turns for full loading; so start out with no turns included initially.

Fig. 3 illustrates a version presently used at W5EHC both for mobile and for fixed station work. Surplus input and output transformers from an aircraft radio transmitter were used, and the two 6C4 tubes were mounted on a small sub-panel situated where the tone transformer originally was located. This method of adding a preamplifier to a push-pull stage fed from a microphone transformer is useful in many mobile installations. Often the microphone requires considerable lung-power for full modulation when no preamplifier is used.

Fig. 4 illustrates a 29 mc version built for W0MCX. Two slug-tuned coils were mounted in the former oscillator coil compartment, the one in the screen circuit being tuned to the crystal frequency (7 mc), and the one in the plate circuit being tuned to the fourth harmonic of the crystal frequency. The original PA plate variable capacitor was removed and original oscillator variable capacitor was used in the plate tank circuit to shorten lead length. Plates should be removed from this capacitor. In two versions of this particular circuit, the

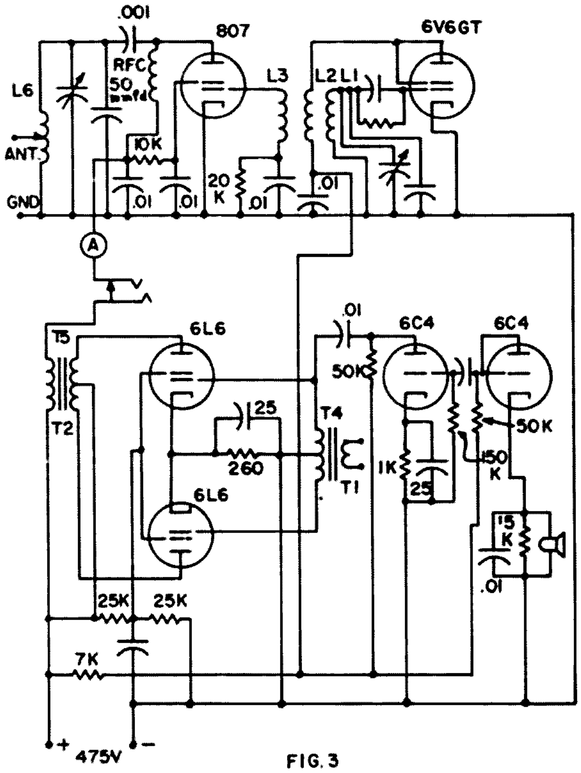


FIG. 3
Conversion for push-pull modulator

author removed the original variable capacitor and replaced it with a 25 mmfd midget mounted on a sheet of insulating material bolted to the front panel; this permitted the use of a direct-drive tuning knob, which facilitated plate tuning.

These circuits by no means illustrate the full variety of conversions readily feasible; the author has used clamp-tube modulation, 6146 finals, and even a crystal-controlled version using a 6V6GT Pierce oscillator and a 6V6GT final.

In Fig. 5 a suggested circuit is shown that makes possible a quick shift between VFO and crystal control. The author has never used this circuit in a BC-230 but has used it with excellent results in other equipment; there is no reason why it shouldn't work well in a BC-230.

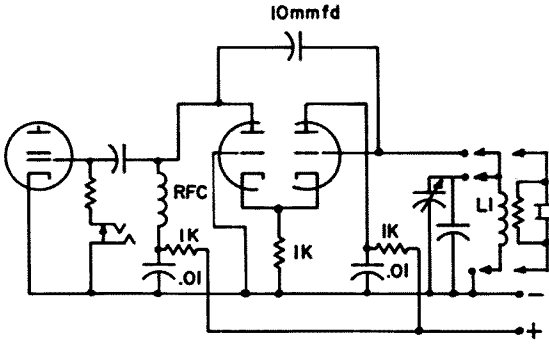


FIG. 5
Suggested oscillator circuit for VFO or Crystal control

If one wanted a really compact transmitter, the circuit shown in Fig. 2, using 25L6 tubes with their heaters in series and with two selenium rectifiers in a voltage-doubling circuit with filters mounted in the space vacated by the tone transformer, permits the entire transmitter to be self-contained.

To get on 7 mc, use the same procedure as for 3.9 mc. For 1.9 mc, however, it will be necessary to add a total of approximately 300 mmfd across the antenna tuning coil in order to resonate the final. Coil sizes for 29 mc de-

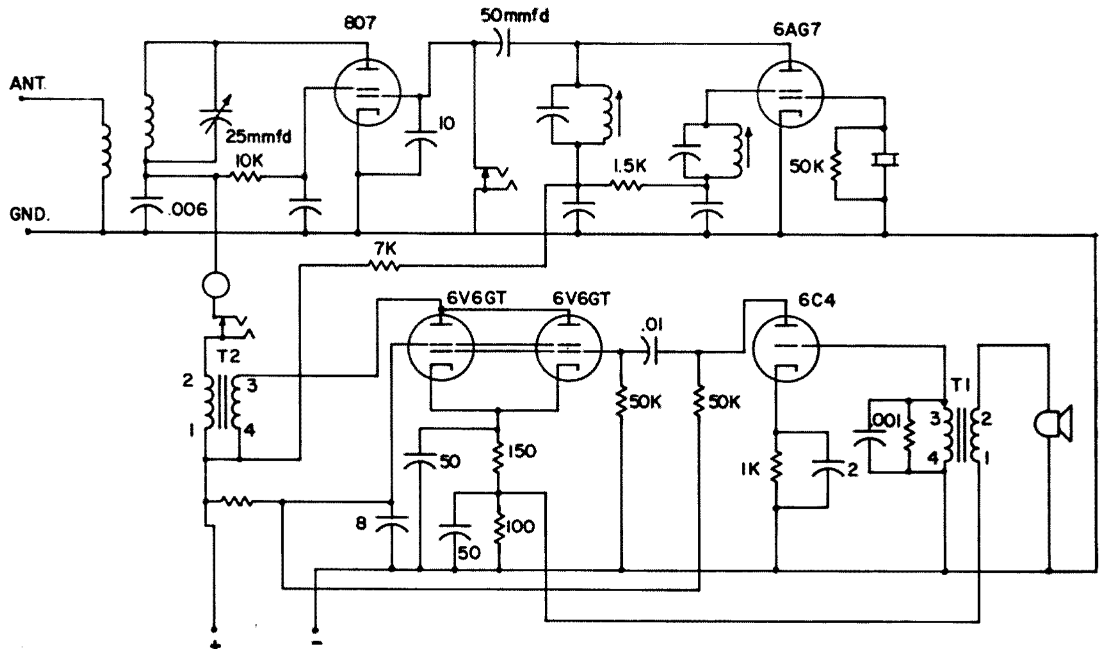
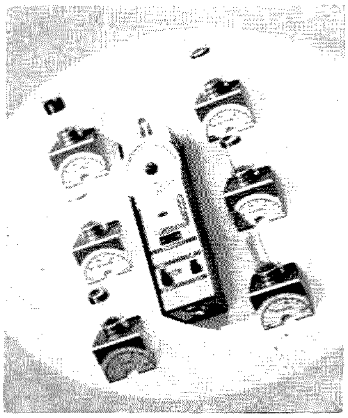


FIG. 4
Conversion for 29 mc

pend upon their associated capacitors; therefore no sizes are given. They are best pruned to size with the aid of a grid-dip meter. Note also that a 10 mmfd capacitor is needed directly from grid to cathode on the PA tube to prevent parasitic oscillation in the 29 mc version. So far, the author has not put a BC-230 on 14 mc or on 21 mc; there is no reason, however, why it could not be done.

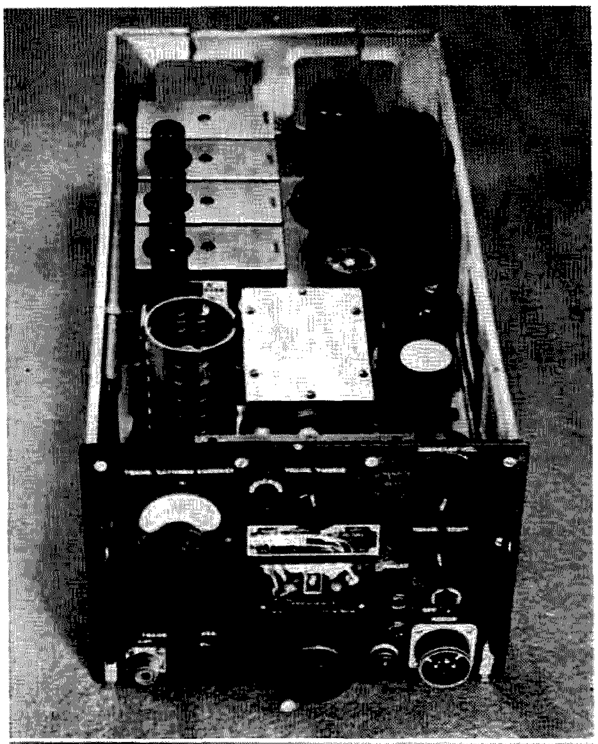
Why not give the BC-230 a trial and see what it can do in either fixed or mobile installations? At W5EHC a BC-230 is used on 1.9, 3.9, and 7.2 mc for short-range contacts while the 813 rig stands idle. Not only is it more sport but less interference is caused to other operators. . . . W5EHC

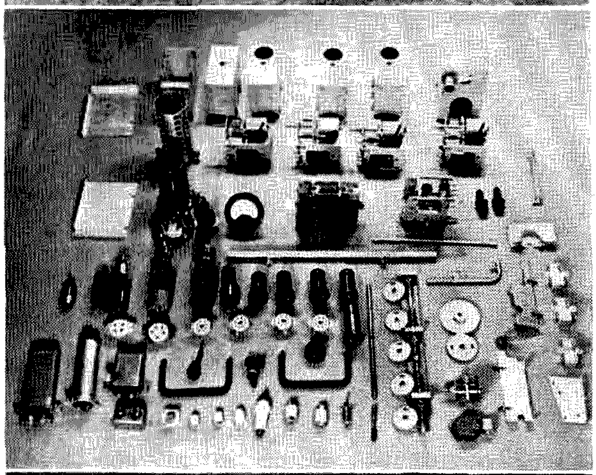
New Product

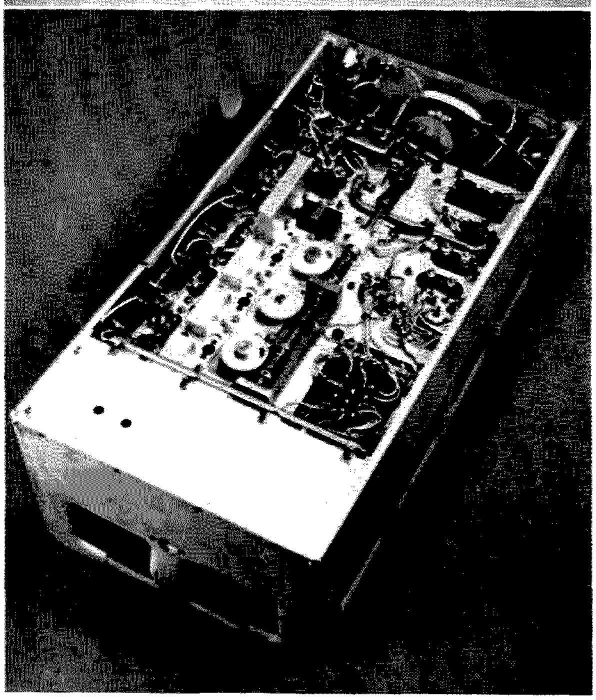


Waters Dippers

Every time you turn around those rascals at Waters Manufacturing have something new for the hams. This is a good deal for us since they put an awful lot of effort into making every product the last word in current technology. Take for instance their just announced "Little Dipper" transistorized radio frequency dip oscillator. You can carry it anywhere and use it without a line cord. This doohinky goes from 2 mc up to 230 mc with seven plug in coils, each of which has its calibration scale attached so it fits under the dial when plugged in. Clever? I'll bet the signal generator companies are gnashing their teeth over the 1000 cycle modulation that is built in. Four little pen light batteries furnish several hundred hours of operation. Price is $129.75, not including the batteries. You'll be seeing these at your distributors.







Photography by Morgan S. Gassman, Jr.

Ecdysiasm

for fun & profit

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Since publication of "The Fine Art of Surplus Utilization" in the November, 1961 73, the writer has been on the lookout for equipment which would effectively demonstrate some of the concepts developed in the article.

The RT-45/ARQ-1 Receiver-Transmitter is an airborne countermeasures equipment which covers the frequency range of 14 to 50 mc. The receiver portion of the equipment is a TRF type with a unique tuning arrangement for covering the frequency range in one band. The transmitter output is an 807 stage which is modulated by a 931A photo-multiplier tube used as a noise generator. The unit has a self-contained 400 cycle power supply. This equipment has been on the surplus market for quite some time and is currently available.

While the RT-45 equipment may have potential use as an amateur band receiver-transmitter, very extensive modification and a suitable power supply would be required. However, inspection of the unit reveals many electronic and mechanical components which would be of great value in amateur construction projects. Just about every category of component discussed in the original article is contained in the RT-45. Refer to the photographs as we run down the list.

The turns counting dial, shown in the center of the front panel view, has a salvaged value approaching the surplus cost of the complete unit. The dial was removed, disassembled and given a coat of flat black spray lacquer. The two other photographs show the refurbished dial mounted on a small sub-panel. This dial is ideally suited for use with rotary inductors and vacuum-variable capacitors.

The various gear drives, some of which are shown in the under-chassis view, separate readily and can provide an easy and economical answer to some of those difficult transmitter layout and construction problems. These gear drives are shown arranged in approximate mechanical relationship in the photograph

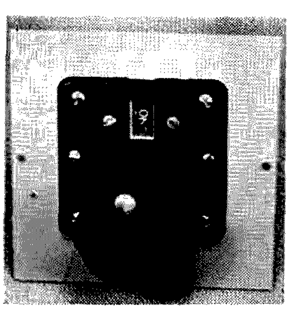
of disassembled components. Also shown in this photograph are the various insulated couplings and both solid and flexible shafting used in the equipment.

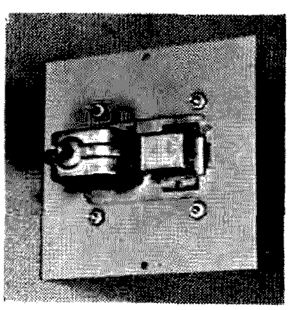
Those small units shown toward the rear of the photograph of disassembled components are an education in themselves. Each of the five units shown has a spirally slotted drum ganged to the shaft of a variable capacitor. A slug tuned inductor is mounted inside each of the assemblies and a projection of the slug drive engages the slotted drum. The net result is a tuned circuit that covers the range of 14 to 50 mc in 180° shaft rotation and which, at the same time, maintains optimum LC ratio over the complete range. Each unit also contains the tube socket and the balance of the components required to provide a complete rf stage.

The RT-45 contains a variety of remarkably "clean" aluminum shield cans, plates and boxes that are directly usable in amateur construction projects. Other usable mechanical parts shown in the photograph of salvaged parts is a super-deluxe 807 shield, panel handles and brass tubing used as shielding in the equipment. Not shown is the sizeable collection of quality hardware that resulted from the stripping operation.

The 931A photo-multiplier tube is a natural for the ham TV man. This tube comes complete with socket and a special die-cast enclosure which is shown to the left of the meter in the photograph of components.

So far, we have discussed only special components. As the photographs show, the RT-45 contains the usual assortment of usable, conventional components. The 0-200 ma meter is a valuable item and the tube line-up, while not spectacular, will serve to augment your stock of old faithful types. The equipment, in addition to the 931A, uses a complement of 6AC7's and one each 807, 2X2A, 5R4 and 6AG7. Only a representative sampling of the smaller parts is shown in the photograph. By using care in disassembly, the usual collection of resistors, capacitors, terminal boards, rf chokes and other parts may be salvaged.





While the RT-45 is a bit different from the usual run of surplus equipment, the salvage operation is routine. Use care to avoid damage to parts, devote a little extra effort to dressing up the really valuable items and give your imagination free rein on possible uses for the often unique components you salvage. Discard those items you can see no possible use for and really clean up those you plan to retain. Then, most important of all segregate and store your salvaged parts as if they were worth their weight in gold. After all, some of them are!

. . . W4WKM

Letters

Dear Wayne:

Since it looks like you are getting hard up for letters to print in *73*, I thought I would take a few minutes from my busy schedule and dash off one to you. What makes me think you are hard pressed for letters? Easy — when you print the same one twice and in issues almost a year apart, you must want more letters.

I'm referring to the letter from Jim Whitfield, K6BHN that I first read in the May '62 issue of *73* — and I might say a fine letter it was — but my eyebrows raised a bit when I read it again, verbatim, in the April '63 issue. Could it be that you run Jim's letter once each year as an anniversary type thing; or is it possible since this is April that you have pulled a little goodie on us?

Whatever the reason may be, feel free to print this as many times as you like. In fact, after each rerun of K6BHN's letter, you could follow with this in the next issue.

Horace Paul W4LCO

Dear Wayne:

Since it looks like you are getting hard up for letters to print in *73*, I thought I would take a few minutes from my busy schedule and dash off one to you. What makes me think you are hard pressed for letters? Easy — when you print the same one twice and in issues almost a year apart, you must want more letters.

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Horace Paul W4LCO

Dear Wayne:

Recieved today my CHC certificate, and I hate it.

True to the high principles of the Club, immediately on receipt I crumpled the certificate and tossed in into a dusty corner of my closet, where I can hate it at a safe distance.

It is a dreary, badly-printed, clumsily-worded, illegibly-signed, mis-numbered, wrongly-dated, smeared and fortunately almost unreadable document.

Every amateur should have one.

Ad astra per CHC,

Charles Leedham
CHC #999,999
WA2TDH

A Beginner's Receiver

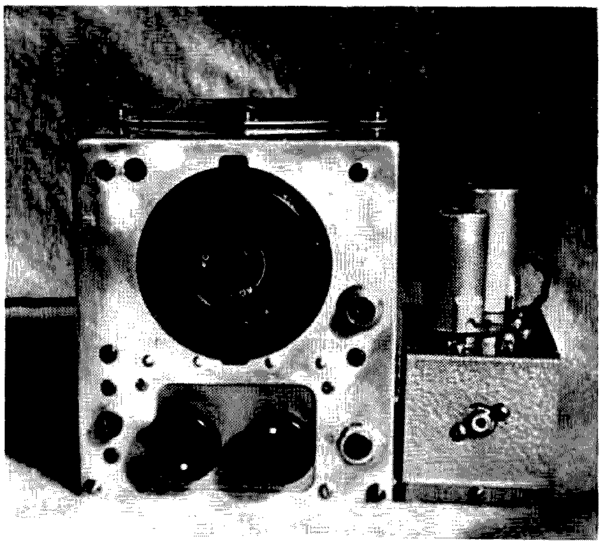
The BC-453

Dick Gridley K6JHJ
Edison Powerhouse #8
Auberry, California

If one piece of surplus equipment could be singled out as the most written about, most modified, and still one of the best buys on the market, it would have to be the BC-453 navigation receiver, or the so-called Q-fiver. The following article is meant to be one more to the credit of this little gem.

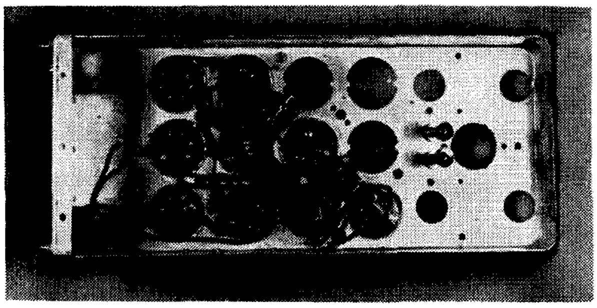
The construction of this unit came into being because of the question asked by each new crop of Novices. "Where do I get a receiver that will perform like the $300 one for $30?" No claim is made that this unit will do all that a super-duper inhaler will, but it will give a surprising account of itself on the band it is used.

The heart is, of course, the BC-453. When finished, it will be a tunable *if* of .19 to .55 mc having a band pass of approximately 3 kc at the 6db points and uses a simple but very effective product detector. Best of all, with a little shopping, the total cost with one converter should not exceed $30. Several advertisers in this magazine have the BC-453's for under $15. It is advisable to get a schematic at the same time, most suppliers have them for $1.00.



Completed unit

As you strip the unit, save all the parts. Some of them will be used later. Remove the top and bottom covers and remove the tubes. Remove the *if* transformers, marking them so you can return them to their original location. On the bottom side—remove all the condensers, chokes, and the output transformer. Remove the two screws holding the ant., rf and osc coil assembly and lift it out. Remove the bfo coil, marking the terminals GRID, PLATE, and B-PLUS. The wiring of the rf stage and the osc stage will be left alone so do not disturb these wires. Remove the plugs in the front and rear of the unit (J1 and J3) and their associated wiring. The one wire that will be saved is the sensitivity line running to the front. Remove the rest. Remove R22 and R23. These are the two 10 watt resistors standing vertically in the rear portion of the receiver. Do not remove the mounts as they will be used later. Take out the dynamotor plug and mounts. Remove the tube sockets for the first *if*, bfo, det., and the audio output tubes. Remove the associated wiring and resistors. Completely remove the resistor board next to the audio stage. Remove the grid biasing, (100K & 150K) and the 200 ohm resistor from the resistor board next to the 12K8. Looking at Fig. 1, the three resistor boards left are referred to as RB1, RB2, and RB3. RB1 should have the original four resistors: a 200 ohm, a 620 ohm, a 360K ohm, and a 200 ohm. RB2 should have only one resistor of 620 ohm, the 12K8 cathode resistor. RB3 has two resistors left: a 510 ohm and a 200 ohm. This com-



Stripped Chassis

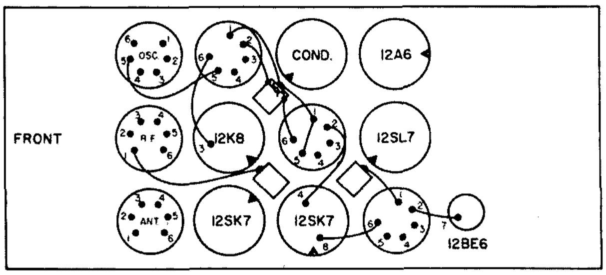


FIGURE 1

Bottom view of chassis.

pletes the stripping on the bottom. Next, remove the cover protecting the three gang tuning capacitor. Above the antenna section you will see an 11 mmfd capacitor connected between the antenna section and the antenna post—clip it out, leaving the leads as long as possible. Remove the antenna post. When stripping the bottom side you pulled a 120 mmfd capacitor from pin 8 of the rf tube and one section of the 3x.05 capacitor that was above it. This 120 mmfd capacitor can now be installed in the top section. Mount it between terminals 5 & 6 of the rf coil (Fig. 1) on top of the chassis, it will fit nicely against the bracket that holds the protective cover. Be sure that the tuning capacitor will clear. It is best to run it through the range to be sure. Finally—drill out the dynamotor bumpers. This should leave a flat surface on the rear deck. Remove the neon lamp across the antenna trimmer condenser C2. This completes the stripping.

The next step is one of pride only, but the author feels it is well worth the effort. That is, to polish up the *if* cans and chassis. S.O.S. works fine. For the *if* cans, remove the covers. Once again be sure that the transformers are marked on the bottom before removing the covers. The BFO coil cover has to be removed anyway, so polish it up too. If your BC453 has an aluminum chassis it also should be worked over, keeping the water out of the tuning assembly. If the unit is black crackle, detergent suds do a nice job with a stiff brush. Clean up the three sockets, the four 3x.05 capacitors, the resistor board and the output transformer.

Reassembly

First cut an aluminum plate to fit the hole on the front where J1 was removed. Cut this plate just large enough to cover the hole—two 6-32's hold it in place. Cut an aluminum plate to cover the rear deck and put a 6-32 in each corner. The first step in wiring is to parallel the filaments of the three tubes that are left. Check the four 3x.05 capacitors. This

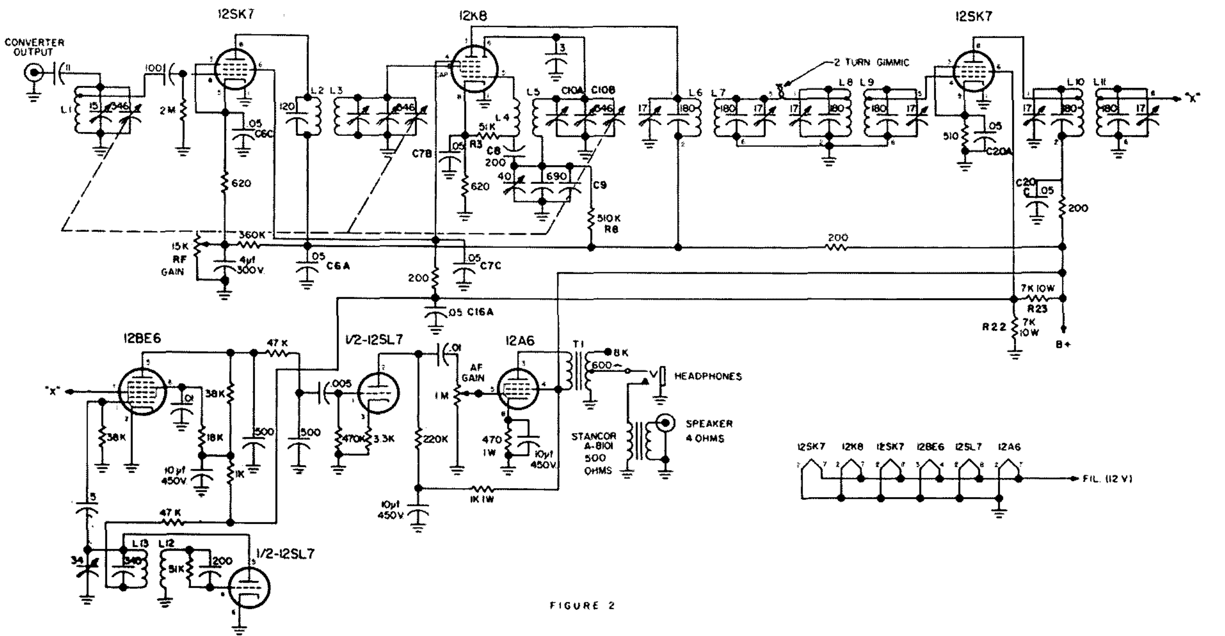
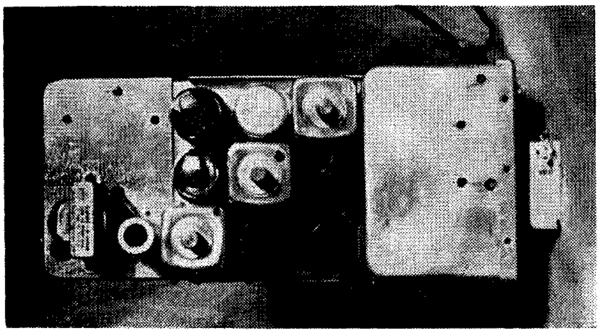


FIGURE 2

Note: R3 R6 C10A C10B C9 and C8 are inside osc coil and in tuning assembly.

can be done using a high resistance scale on a VOM. These condensers are 15 to 20 years old—some of them leak, and leaking condensers we don't need. Taking two of these units that are OK, mount them on their original mounting spots—one over the rf tube socket, and the other over the second *if* amplifier socket. Connect these six sections of the two condensers as shown on Fig. 2. The "C" numbers correspond to the original schematic. The front condenser is used for C6A, C6C, and C7C. The second one is used for C16A, C20A, and C20C. The cathode bypass on the 12K8, C7B, was replaced with a tubular .05 at 400v. This was done only to save space. You can mount one of the 3x.05 capacitors that is left and use one section, but it is a lot better for working around, etc., to use a tubular. Also, for the sharp boys—C16A was originally a .22. However, to save space, one section of the rear 3x.05 capacitor was used and it proves to be adequate bypassing. Mount the rf gain control potentiometer, audio gain potentiometer, and the phone jack on the front panel. Hook up the rf control as shown in Fig. 2. Next, hook up the *if* transformer wiring as shown in Fig. 1 & 2. No attempt was made to make a complete drawing in Fig. 1, the wires to the osc. coil and the 12K8 are only for reference. The B-plus lead that ties to lug 5 of the second *if* transformer will have to be removed and made solid between RB2 and RB3. Referring to Fig. 1—make up the gimmic between the first and second *if* transformers. A wire is run from pin 2 of the first *if* transformer to one of the unused terminals of RB2, and from pin 6 of the second *if* transformer to the terminal opposite. Be sure that the original ground wire is removed from RB2. Insert about a one inch piece of plastic coated solid wire in each of these terminals and solder. Twist the two wires together and cut them off so that a two-turn twist is left. Paint the gimmic with clear dope or fingernail polish to help hold it in case of jarring or hitting it while finishing the project. Install the three octal sockets with the keys as shown in Fig. 1. Mount a lug near C2, the trimmer capacitor, and connect the 11 mmfd capacitor (that was removed from the antenna post) between the stator of C2 and this lug. Directly to the rear of and in alignment with the third *if* transformer, drill and punch a socket hole in the old dynamotor mount for the 12BE6. Mount the socket with the key as shown in Fig. 1. The unit should now correspond electrically with Fig. 2. This is a good place to stop and double check all that has been done.



Completed unit-top

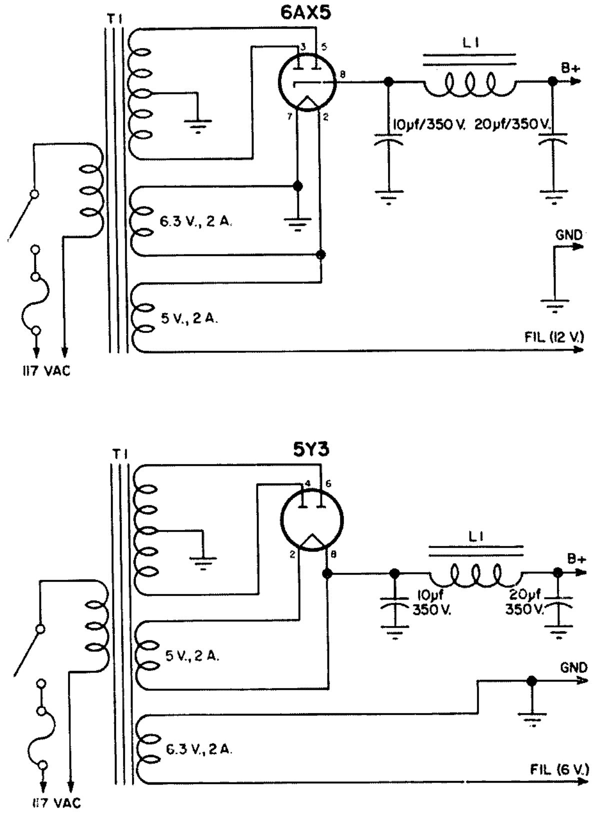
The rest should be easy—from the schematic Fig. 2, and the photos. A couple notes first before installing the bfo coil. With the cover off, open the plates on the trimmer inside the coil to the ½ meshed position. Put the cover back on and mark this position on the cover. Second, there are two types of output transformers (T1). The one with the 600 ohm winding has the terminals marked as shown in Fig. 2. The one without the 600 ohm tap does not have a terminal #6. If you don't intend to use phones, a standard output transformer can be used in place of T1. The condenser used for filtering is not critical, however, do not use less than 10 mfd. I had a 3x10 mfd at 450v octal mount condenser in the junk box—that is the reason the 12A6 cathode capacitor is 450v. 25v will do nicely here. Another decision that will have to be made is whether to go 6 or 12v filament. For 12v filament, you have to buy two tubes, a 12SL7GT and a 12BE6. To go 6v filament, you will have to buy 5 tubes. The additional cost is about $5. There are direct replacement 6v types for all but the 12A6. A 6V6GT does a nice job here.

For a tuning knob—most radio suppliers have a universal ¼ inch plastic knob that is used on TV tone controls, etc. Most of them have a long shaft and can be cut down to fit. The resistance terminal board that was removed and cleaned is returned to its original location and used for the audio stages—one side for the audio and the other for B-plus. The audio wiring on the 12A6 is done before the bfo coil is returned, otherwise it will take long, skinny fingers. How the rear chassis apron is arranged is not critical. The way that I have been doing them is to mount an octal socket in the hole left by J3. Then on the side opposite the bfo coil and output transformer, drill a ¼ hole in the apron as close to the top corner as possible for the antenna lead. Mount an RCA phono jack also close to the same side but about center between top and bottom. Then, close to the octal socket, drill a hole for a rubber grommet. A short piece (about 15 inches) of RG-58 A/U is connected to the 11 mmfd capacitor attached to C2 and brought out through the ¼ hole—This is the converter input. The 4 ohm winding from the A8101 line to voice coil transformer is connected to the RCA phono jack for the speaker. A three-wire power cable is run through the grommet and connected to any three lugs on the octal socket. Be sure and ground the ground lead to the chassis. This octal plug is now a power plug for the converters, and the inside lugs are the common tie points for the BC-453. Return the cover of the tuning assembly, the *if* transformers, and install the tubes. Remove the top covers on the *if* transformers by unscrewing them, and pull the coupling rods all the way out for minimum coupling. Return the covers. This completes the assembly and you are now ready for alignment. But first it is best to double check everything you have done before applying power.

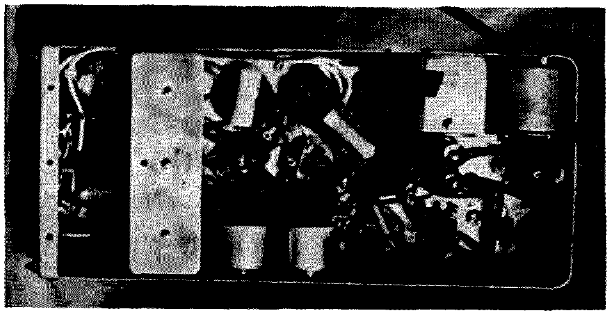
Power

The converted unit draws 60 ma B-plus at 250 vdc and 12.6v at .1 amp . . . Two ways to come by this is shown in Fig. 3. This is where

FIGURE 3



T1 500 to 550 volts ac center tapped 80 ma
L1 6 hy 80 ma filter choke
Note: No bleeder is used as R22 and R23 present a load of 14K ohms at all times.



Completed unit-bottom

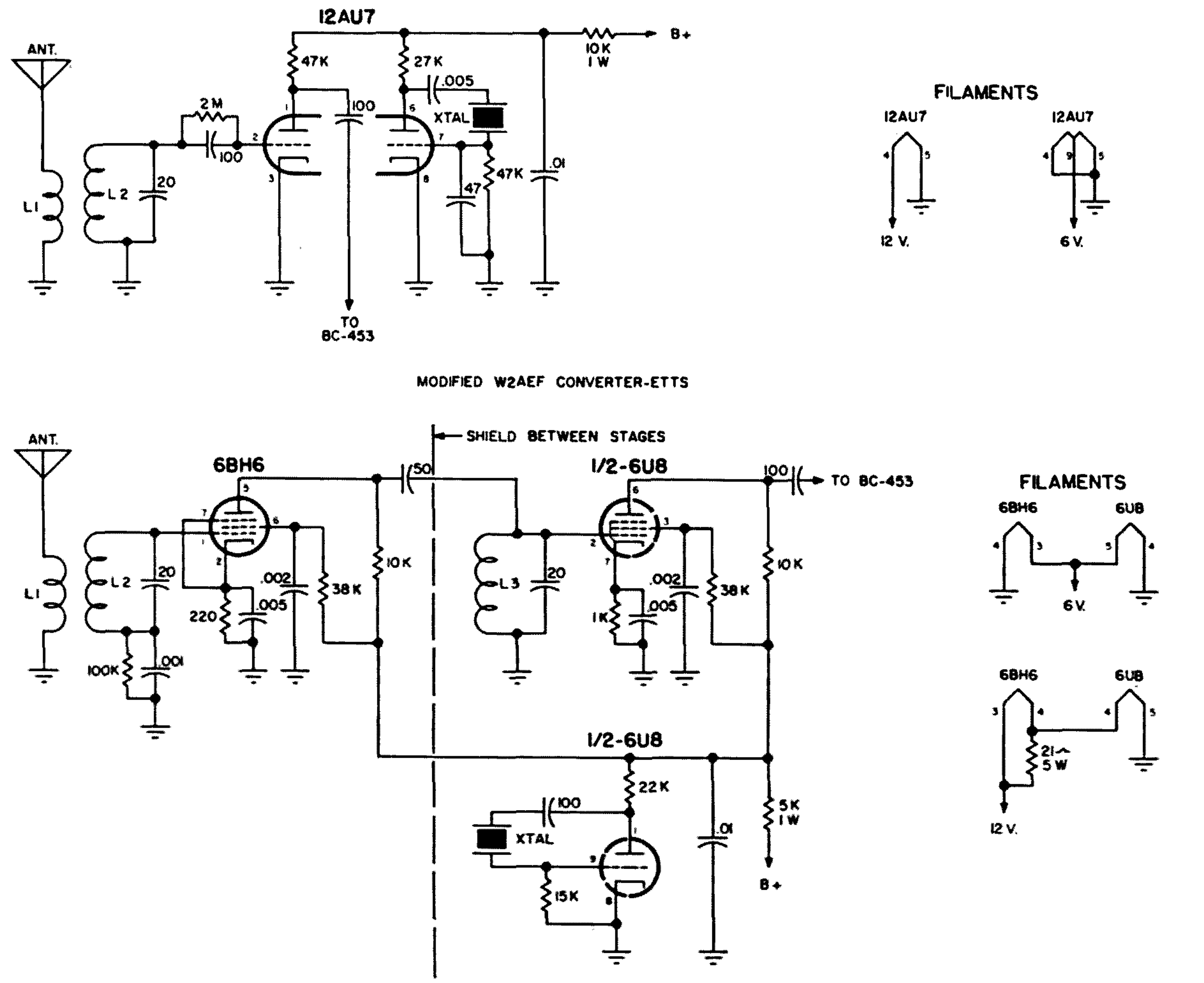
you must shop around to save money. There are many good power transformers and chokes available on the surplus market. If you buy new components for a power supply, the price will be costly. The voltage is not critical, anything between 225 vdc and 275 vdc will do. With a single converter, the total load is 75 ma—so a total load of 80 ma is all that is required.

Check-out and Alignment

Connect a speaker or phones to the unit and apply power. Turn the rf gain wide open and advance the audio gain until you hear noise. The ambient noise level of this unit is quite low but you will hear a definite gain if you connect an antenna to the coax that will connect to the converter. The ultimate alignment is done with a scope and a low frequency sweep generator, using the bfo frequency as a marker for the center of the band pass. The sweep and the marker frequency being introduced at pin 5 of the 12K8 with pin 8 grounded, and an rf probe feeding your scope from pin 7 of the 12BE6. Using this method, a band pass of 3 kc at the 6db points can be achieved.

Knowing most shacks do not have a low frequency sweep generator and some don't have a scope, two other methods are offered—either will perform satisfactorily. If a VTVM is available, remove the 5 mmfd capacitor from pin 1 of the 12BE6. Ground pin 8 on the 12K8 mixer tube. Connect a piece of wire to the 5 mmfd capacitor and connect the other

CONVERTERS
FIGURE 4



L1 4 T wound on ground end of L2
L2-L3 Coils wound to frequency on ¼" x 2" form with #30 enameled wire
Crystal: 80M-3.5mc, 40M-6.8mc

end to pin 5 of the 12K8. Apply power and with an rf probe on pin 7 of the 12BE6, peak the *if* transformers for maximum voltage. Remove the ground on pin 8 of the 12K8 and the wire to pin 5. Reconnect the 5 mmfd to pin 1 of the 12BE6. Move the bfo trimmer ⅛ turn in either direction.

If a VTVM is not available, a satisfactory way is to apply power and connect an antenna wire to the RG-58 A/U converter input. Turn the af and rf gain until you can hear static noise. Check to make sure this is coming in the antenna by taking off the antenna wire and the noise should drop off. Hook the wire up again and peak the *if* trimmers for maximum noise. Next, move the bfo trimmer capacitor about ⅛ of a turn in either direction. This completes the conversion.

The Converter

Any pet converter will work fine with this rig—some fellows have used single tube converters with good success. The one I recommend is the old standby W2AEF Converterettes. Two suggestions are offered in Fig. 4, but any converter with the *if* frequency of the BC453 will do. Both are built on 4"x2⅛"x1⅝" chassis (Bud Minibox).

Conclusion

Once completed, the unit is a nice piece of equipment well worth having. It makes a dandy stand-by receiver and if you purchase a receiver that is quite broad, this unit can be used as an outboard *if* to sharpen it up. If you want to demodulate SSB, all you have to do is line up on a SSB station and trim the BFO coil to the correct side of the band pass for good sounding signals.

A lot of equipment for a minimum investment. I hope you enjoy yours as I do mine.

. . . K6JHJ

Sign in the shack of K7GPZ:

Verboten Notischer

ACHTUNG! Alles lookenspeakers in das hamschacken: Das radiomachinen is nicht fur gefinkerpoken. Und mitten graben. Ist easy schnappen der springenwerk, blowenfusen und poppenkorken mitt spittszensparken. Ist nicht fur gewerken by das dummkopfen. Ich have license from der Sammy Unkle. Running das radiomachinen by dummkopfen mittout license makkin hoosegow geput or marks gepayen. Das rubbernakken sightseer keepen hands in das pockets. Relaxen,—to das goofy sprechen gelisten, un das bouncing meterish pointer gewatchen.

Power Tuning

Ronald Ives
2075 Harvard Street
Palo Alto, California

With the very low tuning rates of many modern receivers, the labor of tuning from one end of the dial to the other is considerable. If, as is often done, a subsidiary planetary drive is added, the operator may come down with "nailer's wrist" as a result of tuning across the band too many times in succession. What is needed here is a simple motor drive to save wear and tear on the operator's wrist.

Only a few modern receivers are so designed that a Zenith remote tuning mechanism can be added, and fewer yet can accommodate the power tuning mechanisms furnished as integral parts of some military receivers, such as the R-44/ARR-5 and the R-54/APR-4. Construction, "from scratch" of a motor tuning drive seems beyond the facilities available to most operators.

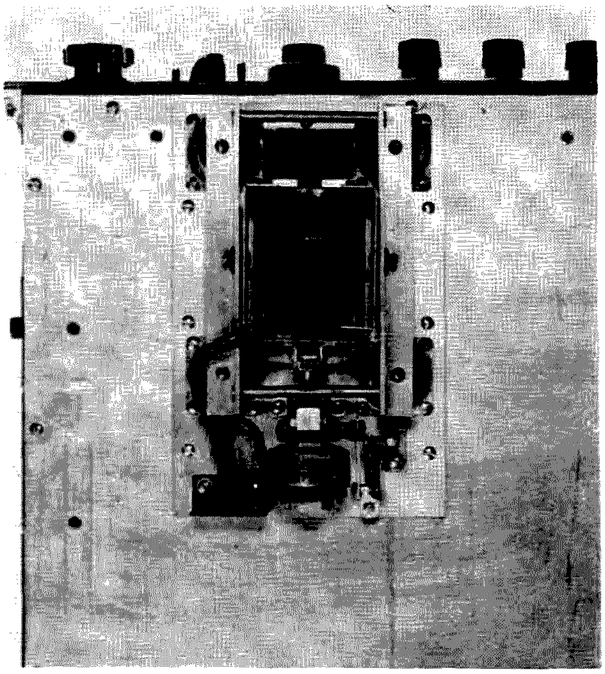


Fig. 1: Motor drive mounted on bottom plate of receiver.

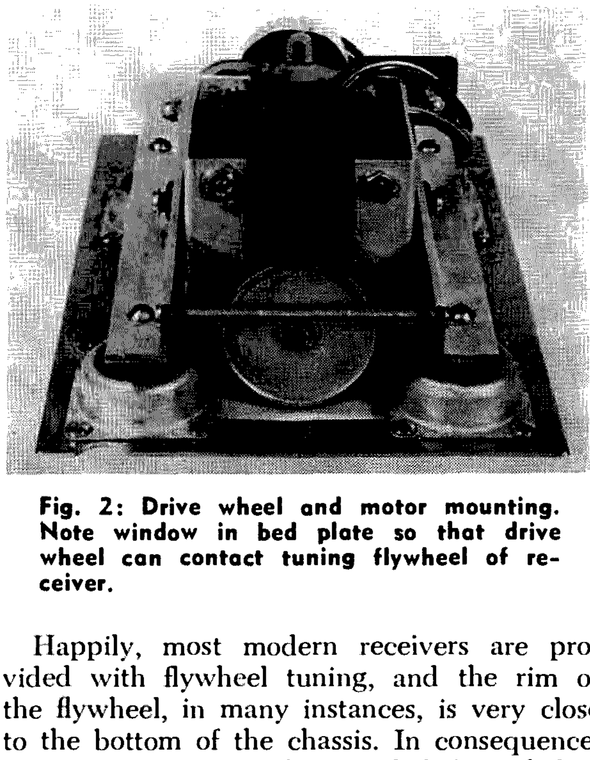


Fig. 2: Drive wheel and motor mounting. Note window in bed plate so that drive wheel can contact tuning flywheel of receiver.

Happily, most modern receivers are provided with flywheel tuning, and the rim of the flywheel, in many instances, is very close to the bottom of the chassis. In consequence, a friction drive can be coupled from below without requiring major surgery on the receiver. Some experimentation shows that a combination drive and clutch can be constructed successfully from standard components, without requiring any critical machining, close fitting, or "persnickety" alignments. View of such a drive, mounted on the bottom of a receiver, is shown in Fig. 1. Requisite parts are a motor, a relay actuator, and a hatful of small inexpensive parts.

In this power drive, the motor is mounted on gimbals, and is equipped with a rubber-tired drive wheel (a 2" o.d. Webcor idler wheel) on one end, and an electromagnetic tilting mechanism (Leach type 957-V impulse relay magnet) on the other. When the electromagnet is not energized, the drive wheel (Fig. 2) is held away from the receiver tun-

ing flywheel by a spring. When the electromagnet is energized, the whole motor assembly tilts forward, contacting the tuning flywheel, and driving the receiver tuning mechanism.

Practical consideration of desired tuning rate, power needed, and type of motor control desired led to the choice of a 360 RPM capacitor start and run motor, with a torque of 2.6 inch-ounces (Bodine type KYC 26). This was equipped with two C-shaped side plates, in the centers of which the gimbal pivots were mounted. These, in turn, were supported by a cage, made from aluminum angle and threaded spacers. This assemblage was fastened to the bed plate with rubber shock mounts, which give the system the requisite degree of "slop," so that precision machining is not needed in its construction. Details of construction are shown in Fig. 3.

The electromagnetic actuator, with its integral bell crank, is mounted on the bed plate

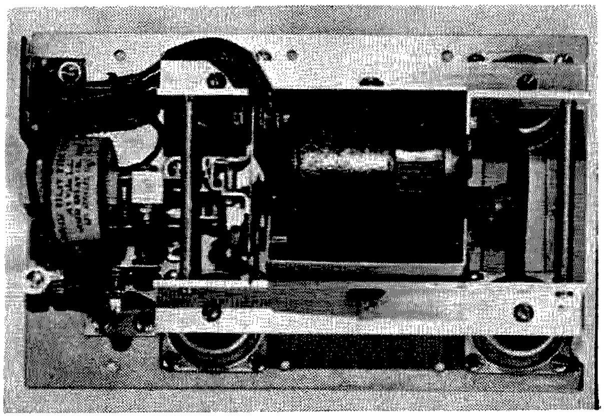


Fig. 3: Completed motor tuning drive, demounted from receiver.

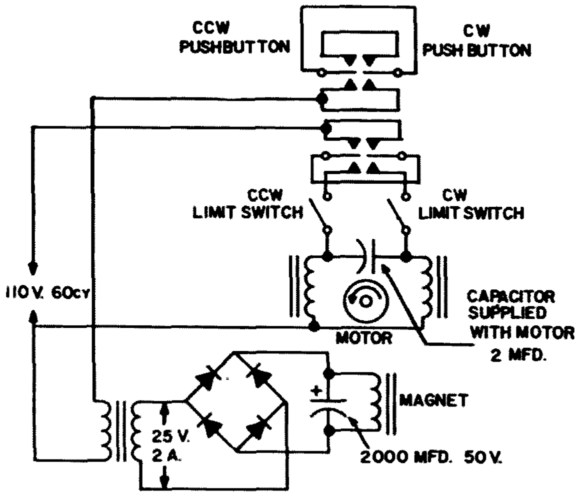


FIG. 4

Fig. 4: Power tuning control circuit.

behind the motor, and coupled to it with a pivoted push rod. This attaches to the motor by means of a bridle, held in place by two of the motor case screws. Adjustment for smooth operation is greatly facilitated if the push rod is slotted, so that the degree of engagement of the drive wheel with the tuning flywheel can be adjusted, and system wear compensated for from time to time.

With this adjustment, plus the systemic "slop" provided by the rubber shock mounts, smooth operation can be attained without the need for close machining of the parts. So long as the general principle of operation is followed, exact construction can be modified considerably to suit the materials and components available.

Electrical control of this power tuning drive can be as simple, or as complex, as the user desires. For ordinary tuning, push-button controls seem optimum, with one button for clockwise rotation of the tuning drive wheel, and a second for counter-clockwise rotation. One of many circuits which perform this control function is shown in Fig. 4. Here, a two-circuit push button energizes the motor for one direction of rotation, and also actuates the magnet circuit, which couples the drive mechanically to the receiver tuning mechanism. The interconnections of the push button arms are intentional, and prevent trouble in the event that someone pushes both buttons at once. If that is done, nothing happens!

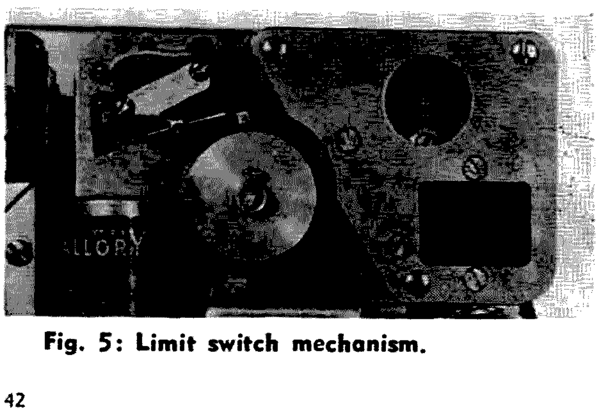


Fig. 5: Limit switch mechanism.

The purpose of the limit switches shown in Fig. 4 is to prevent damage to the tuning machanism when the end of a tuning range is reached. These, as here applied, are a system of cams and microswitches (V-3 switches with JV-20 actuators), coupled to the tuning shaft, and wired to cut off each direction of rotation at the end of its range. Such a limit switch mechanism is shown in Fig. 5. There are two cams and two switches in this figure. Electrical connections are made by means of the Jones plug at the right center of this figure. Cams are made from defunct brass gears, with the slots hand-filed to desired dimensions.

Service life of this tuning mechanism is problematical, as it outlasted the receiver for which it was built (8 years). With new rubber shock mounts, and a new tire on the drive wheel, it could well last another decade of service. Maintenance needs during this time included only the replacement of a selenium bridge rectifier in the magnet circuit. Modern silicon rectifiers in the same current range are apparently immortal, so that this trouble should not recur.

. . . Ives

An Inexpensive Beam Rotor

Bill Hurni K1SDR
175 Raymond St.
Darien, Conn.

Have you got a tower, a beam, and no cash to buy a rotator? That happened to be my situation until about two months ago. At that point I'd had it. I decided there must be some way to construct an inexpensive yet practical antenna rotator. A little shopping, a little work and the expenditure of about fifteen dollars produced the result.

The rotator is constructed around the top hat of an E-Z Way tower. The assembly is so simple that it can be adapted to any tower. It has positive braking and 320 inch pounds of torque at about ¾ RPM.

The parts in this rotator weigh five pounds.

They are itemized below along with the prices for those skeptical about the fifteen dollars.

Worm gear (Astrup)	\$5.00
Surplus motor Cat# 441-1008 24vdc	\$5.95
Rotor cable	\$1.65
Machine work	\$1.30
Transformer	\$1.00
	\$14.90

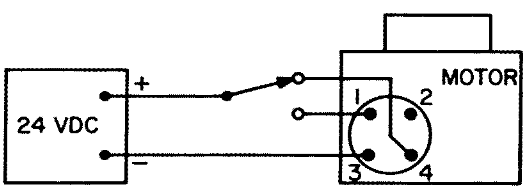
A picture is worth a thousand words so before proceeding study the one included.

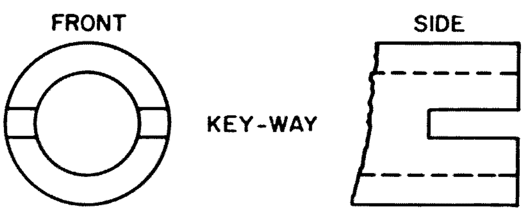
The worm gear was obtained from a local awning shop. These worm gears are normally used in the crank operated mechanism for raising and lowering the large awnings on store fronts. They are easy to come by.

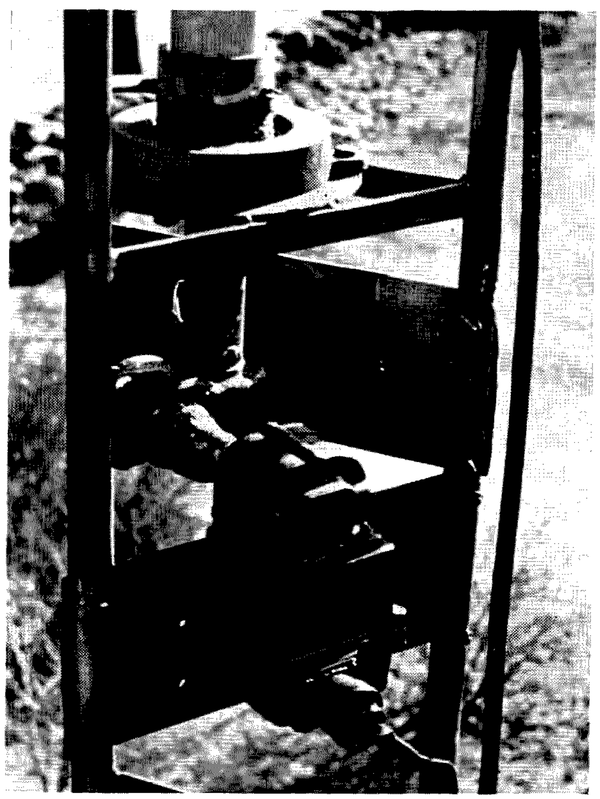
The motor is a surplus 24vdc job cat# 441-1008 purchased from Fair Radio Sales in Lima, Ohio. It includes an integral right angle drive, gear reduction unit. This particular motor seems to be designed for out door use since it is completely sealed.

Only a few notes on construction are necessary. The rotator is assembled directly into the tower. When building the rotator into the tower it is of the utmost importance that all of the joints are free and that there is no binding. This is a question of alignment, for example, between the worm gear and the antenna mast or the worm gear and the motor.

This alignment is easily accomplished. The worm gear is mounted on a suitable piece of aluminum plate a little longer that the width







of one side of the tower. This assembly is temporarily clamped into its approximate position on the tower with "C" clamps.

Fine adjustment of the connection between the worm gear shaft and the antenna mast is then made by juggling the aluminum mounting plate around until the two shafts are aligned and turn freely. The "C" clamps are then tightened to hold the mounting plate firmly in place. It is then a simple matter to drill the mounting holes through the aluminum and the tower.

If the same procedure is followed with the motor, no difficulty should be encountered in alignment of the rotator.

The diagram of the key-way needed to connect the motor to the worm gear is self explanatory. The key-way, which is cut into the worm gear shaft, can be done at a machine shop for a nominal fee.

The power supply for the motor is a simple full wave 24 vdc unit. The motor draws approximately .8 amps in operation. The diagram shows the way in which the power supply is wired to the motor. The positive lead is switched to pin 4 for clockwise rotation and to pin 1 for counter clockwise rotation.

At my QTH an indicator was not necessary but a pair of surplus selsyns could be added with no difficulty.

After you have assembled the rotator, pack all the joints with heavy grease and put the assembly on your tower. I am sure that you will be as satisfied with your rotator as I am with mine. . . . K1SDR

The Lazy Man's CW Monitor

Al Singer WA2WFW

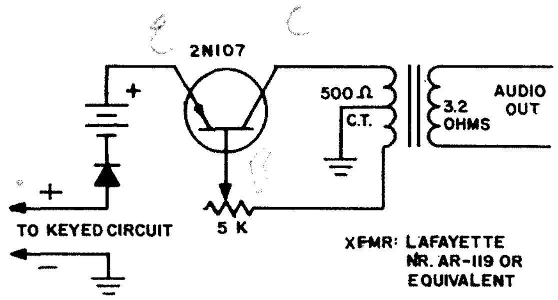
The circuit shown below is the simplest possible form of a CW tone I've run across. I'm sorry I can't take credit for the design of this circuit; I heard it being described over the air on 20 fone, and the bug bit me to build it.

The resistance range of R1 should fall between 1000 and 5000 ohms. A fixed resistance may, if so desired, be substituted.

Almost any transistor may be used, as the whole circuit is powered by a penlite cell. The diode assures the transistor's safety, by protecting it from the current found across the key jack.

The audio output transformer is just about the most expensive part in the whole gadget. It is used to match the 500 ohm output impedance of the circuit to whatever you happen to be driving. The audio output is sufficient to drive a speaker. The unit has been used as a code practice oscillator to instruct a rather large group. No complaints were voiced as to the volume.

One word about the diode, though. Make sure it has a sufficient PIV and current rating so that if placed across your key backwards the diode's backward conductance will not be great enough to put a signal on the air.



People with homebrew keyers might want to build this unit into the keyer for a sidetone generator. I preferred to build it right into the rig, so that can monitor myself when using the old bug. I'm sure many of you can find a use for this cheap little gimmick.

. . . WA2WFW

Parts Kit Available

The parts for this unit catalog at $4.62. They are available as a package thru the 73 Parts Kits Program at only $4.25, complete. See info on kits on page 123. Order WA2WFW Kit.

A Deluxe Conversion of the Command Set Antenna Relay Unit

The BC-442

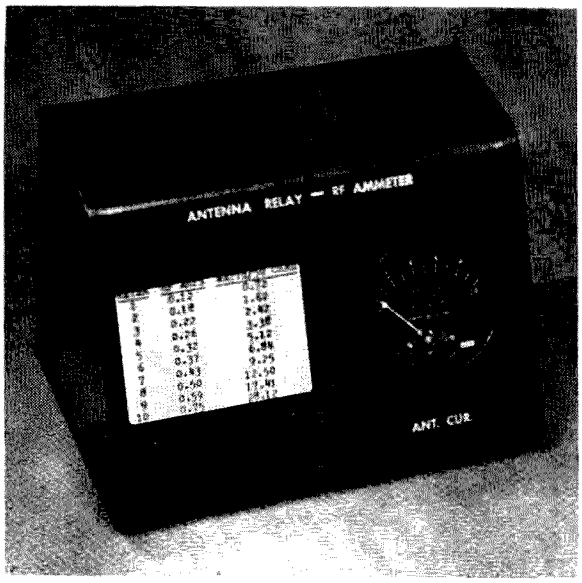
Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Photographs by: Morgan S. Gassman, Jr.

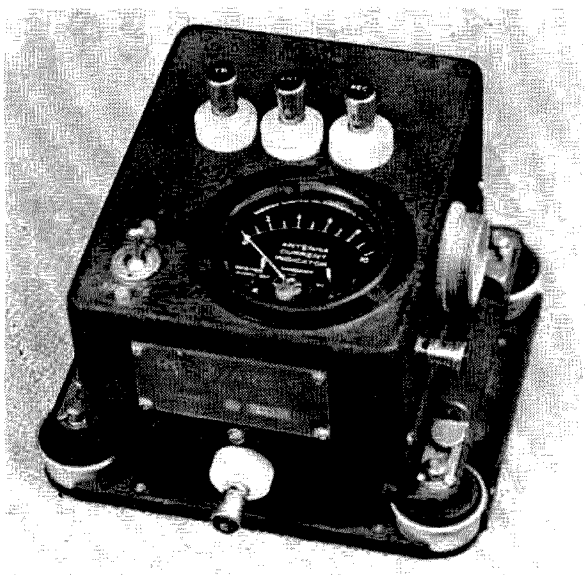
Antenna Relay Units BC-442, used in Radio Set SCR-274-N, and RE-2/ARC-5, used in Radio Set AN/ARC-5, are widely available on the surplus market. While not too popular in the past, these versatile little units give you a lot for your money. This article presents a de luxe conversion of these Command Set accessories which has several advantages over those previously described.[1] This conversion features commercial appearance, low cost, calibration data, push-to-talk circuitry and a unique relay power source and circuit.

The photograph shows the AN/ARC-5 version of the Antenna Relay Unit as you will find it at your surplus dealers. Figure 1 shows the schematic diagram of the SCR-274-N version. Major components of these units consist of a 0.75 ampere rf ammeter with external thermocouple, a powdered iron core rf transformer to couple the thermocouple to the antenna circuit, a 28 volt dc antenna change-over relay and a 50 uuf fixed vacuum capacitor. In this conversion, the meter, thermocouple and relay are used for their original purpose, the antenna transformer is discarded and the vacuum capacitor regarded as a bonus and retained for future projects. To improve the appearance, the unit is stripped and the components assembled in a commercial, sloping front case.

The meter, M50 of Figure 1, is an expanded scale dc millivolt meter with an open circuit, full scale rating of 19.5 millivolts. DC resistance of the meter is three ohms. While the meter has an arbitrary scale calibration of



The completed station rf accessory unit using Command Set Antenna Relay Unit components.

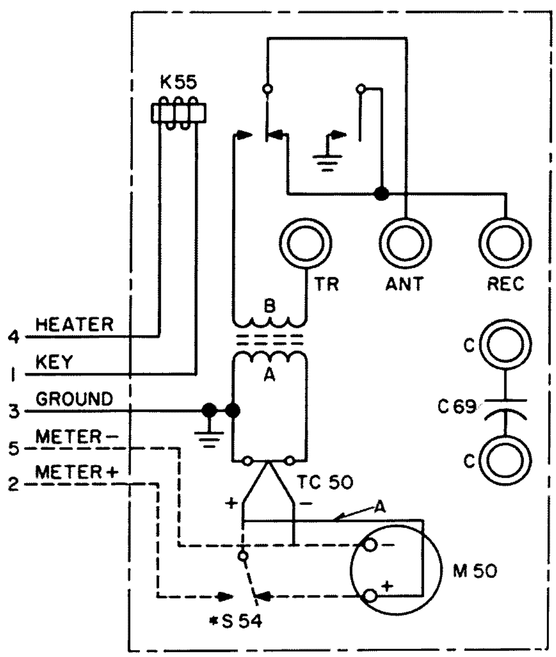


The RE-2/ARC-5 Antenna Relay Unit as used in the AN/ARC-5 Command Set installations.

0 - 10, the range of the meter when used with the thermocouple, TC50, is 0 - 0.75 rf amperes. A test setup was made, using an rf ammeter of verified calibration, an rf vacuum tube voltmeter and a flat 50 ohm load. RF voltmeter and ammeter readings were averaged to obtain the following data for the meter and the thermocouple:

METER READING	RF AMPERES	WATTS/50 OHMS
1	0.12	0.72
2	0.18	1.62
3	0.22	2.42
4	0.26	3.38
5	0.32	5.12
6	0.37	6.84
7	0.43	9.25
8	0.50	12.50
9	0.59	17.41
10	0.75	28.12

Spot checks disclosed little variation in readings over the frequency range of 3.5 to 60 mc. While the basic 0 - 0.75 ampere range is a bit low for most amateur use, it does meet many shop and on the air requirements. Tests were conducted and it was found that the thermocouple could be satisfactorily shunted to increase the full scale range. The antenna change-over relay, K55, is capable of handling considerable power so it was decided to incor-

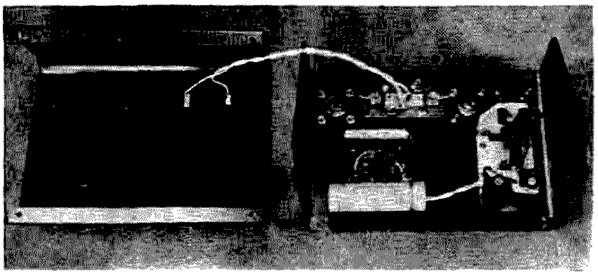


ANTENNA RELAY UNIT
BC-442-A

FIGURE I

* Note on S 54. S 54 and connections shown in dashed lines were provided in earlier models of antenna relay unit BC-442-A. Lead A was left out in units where S 54 was used.

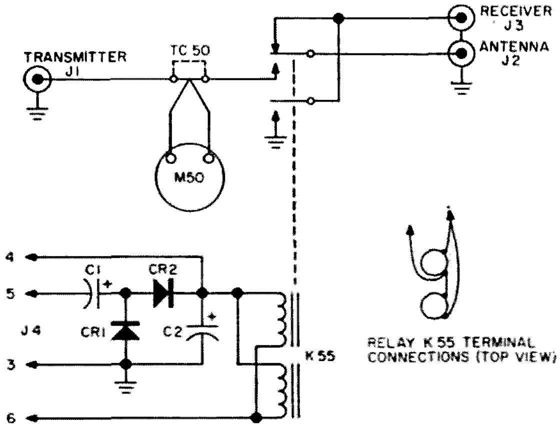
[1] See pages 16 and 17 of "INDEX TO SURPLUS," W4WKM; available at $1.50 from 73 MAGAZINE.



Interior view of the completed rf accessory unit. Note use of the octal socket terminals as power supply component tie points and the short, direct rf leads. RF shunt, described in the text, was not installed at the time of the photograph.

porate the relay along with the rf ammeter circuitry into a station accessory unit.

At this point, the conversion began to take shape. The power requirement for the relay caused a bit of head scratching, however a rather unique and perfectly acceptable solution was developed. As shown in the photographs, the relay is a dual coil unit with both windings brought out to terminals. By connecting the windings in parallel, instead of in series as in the original wiring, the power requirement becomes 12 volts dc. Most low power commercial transmitters have 6.3 volts ac available at an accessory socket. Since we must wire into the transmitter control circuitry to obtain push-to-talk operation, it is a simple matter to utilize this 6.3 volt source as the control voltage. Figure 2 shows how this is accomplished. A simple voltage doubler rectifier circuit is installed in the accessory unit and this voltage used to power the antenna change-over relay. This same supply may be used to power an auxiliary 12 volt dc relay if this is required in the station control system. Figure 2 shows the connections required for a typical push-to-talk installation.



4 12 VDC TO OPTIONAL AUXILIARY RELAY.
5 6.3 VAC FROM TRANSMITTER ACCESSORY SOCKET.
3 TO TRANSMITTER AND STATION GROUND.
6 TO PUSH-TO-TALK SWITCH AND OPTIONAL AUXILIARY RELAY WITH GROUND RETURN.

NOTE: SEE TEXT FOR THERMOCOUPLE SHUNT INFORMATION

FIGURE 2

C1-C2	500 mfd, 25 WVDC electrolytic
CR1-CR2	1 A, 50 V PIV silicon diode
J1-J2-J3	SO-239 coaxial receptacle
J4	octal socket
K55	original relay, wired as shown
M50	original meter
TC50	original thermocouple

As shown in the photographs, construction of the antenna change-over unit is straightforward. The components are mounted in a Bud AC-1612-A sloping panel aluminum utility box which measures 4" x 6" x 4¼". The antenna, transmitter and receiver SO-239 coaxial connectors and the thermocouple are mounted in a row across the top of the back cover. The antenna relay is mounted below the connectors and positioned to insure the shortest leads. External connections are made to the octal socket, J4. This connector is also used as a tie point to mount the various relay power supply components. Mounted on the front panel of the box are the meter and a surplus chart frame which is used to secure the meter calibration chart. The photographs show the construction details. Wiring to the thermocouple should be as short and direct as possible and the layout shown provides for this. Use solder lugs to make the connections to the thermocouple.

Use stranded, twisted pair to make the connection between the thermocouple and the meter. Figure 2 shows the proper connections to the relay. Do not reverse these connections or the relay will not operate.

The rf side of the thermocouple may be shunted as shown in Figure 2 to increase the range of the rf ammeter. In the prototype, the range of the meter was exactly doubled by installing a shunt made of a direct strap of #16 copper wire connected directly between the thermocouple terminals. When installing such a shunt, keep the shunt as short and direct as possible. Regulate the range by the size of the conductor, not the length. Use soldering lugs to insure good contact to the thermocouple terminals. Calibrate the shunted thermocouple-meter combination by connecting the instrument in series with another rf ammeter of verified calibration and connecting rf power. While the shunted thermocouple is frequency dependent, the error is not as serious as you might expect. The prototype meter, with the #16 wire shunt across the thermocouple, was connected in a test circuit in series with a standard rf ammeter and readings taken at various frequencies. In each case, output was adjusted to obtain a reading of 0.8 (1 ampere rf) on the shunted meter and the actual current read from the standard meter. Results were as follows:

BAND	RF CURRENT
10 M	0.9
15 M	1.0
20 M	1.0
40 M	1.0
80 M	1.2

Components of the Command Set Antenna Relay Units make a very satisfactory rf accessory unit for amateur use. Use of a single-package rf metering and antenna change-over unit is highly recommended as a simple means of clearing up some of the haywire around the shack and as an extremely useful station accessory. . . . W4WKM

FOREIGN SUBSCRIPTIONS

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England	28/6	Spain	200 Ptas
Finland	14.2 FM	Sweden	20.80 SKr
France	20 NF	Switzerland	17.50 SFr

Book Reviews

K1APA

Are you looking for a very complete text on test equipment? ELECTRONIC TEST INSTRUMENT HANDBOOK (Howard Sams ETI-1) examines the theory and practical use of about every conceivable testing device that the technician, engineer or radio amateur will use. Of special interest are chapters on audio test equipment, frequency and modulation measurements, capacitance, inductance and impedance tests. Soft-cover, 288 pages, $4.95

Leonard Lane has just written a two volume set (Rider #310) entitled ELEMENTARY INDUSTRIAL ELECTRONICS. These books are aimed at the service technician or technical school student who needs a working knowledge of how electronic equipment is used in modern industry. Sofe-cover, 2 vol. set, 325 pages, $7.80

HOW TO SOLVE PROBLEMS IN ELECTRICITY AND MAGNETISM by Henry Jacobowitz, samples and solves typical problems a student of the subject would encounter. This text (Rider #302) is an ideal addition to the library of the ham, technician or engineering student who wants to develop his ability to handle problems. Included are chapters on ac and dc circuits, electromagnetism, transistors, modulation, transmission lines, waveguides, cavity resonators and antennas. Soft-cover, 185 pages, $3.50

The Radio Society of Great Britain recently published a RADIO DATA REFERENCE BOOK. This text, compiled by G. R. Jessop G6JP, presents commonly used material in the form of curves, tables and charts. A wealth of information for the amateur! Hard-cover, 136 pages, price 12/6. Available from R.S.G.B., Russell Street, London, England.

RADIO TV-ELECTRONICS DICTIONARY (Rider #307) contains in 190 pages just about every term that one could encounter in the field of electronics. In addition to the clear and concise definitions this text contains a section on abbreviations and symbols. Soft-cover, $3.50

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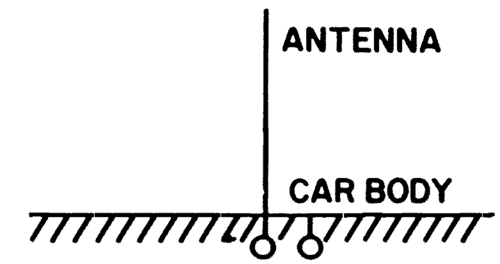
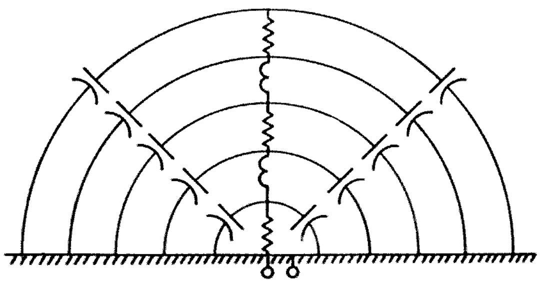
Howard Sams has just released a book, written by Edward Noll, entitled MODERN COM-

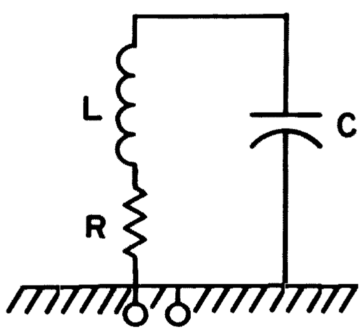
Robert Bonebrake W9GCQ
21 Indian Drive
Clarendon Hills, Illinois

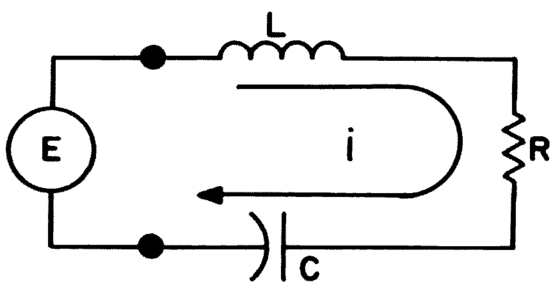
The Function of the Loading Coil

in mobile antennas









With the increasing number of mobile stations, the use of inductively loaded antennas is becoming more and more common. The large variety of commercial loading coils on the market makes it easy to put a mobile station on the air and even home-built coils can be adjusted and used without knowledge of how they operate in the antenna circuit. It is the purpose of this article to point out what role the coil plays.

The principles set forth in this article are applicable to any inductively loaded antenna system, although the emphasis here is on the mobile station. For the purpose of this article, the effects of the ground on which the automobile is standing or moving are neglected, even though they may become appreciable at the lower frequencies.

Consider the antenna shown in Fig. 1.

Radio frequency current applied at the terminals encounters resistance and inductance in the antenna (as any alternating current does in a wire). It also flows through the capacity between the antenna and the car body. Therefore, to the current flowing into the input terminals, the antenna appears as shown in Fig. 2, where there are an infinite number of resistors, capacitors, and inductors distributed along the antenna.

To aid in the analysis of Fig. 2, the circuit may be approximated by lumping the resistances, capacitances, and inductances into three units, as shown in Fig. 3. This is recognizable as a series circuit, and it is important to realize that, when properly adjusted, the operation of the antenna is similar to that of a series resonant circuit. For this reason, it is necessary to understand some of the principles of this type of circuit.

MUNICATIONS SYSTEMS (MCN-1). This volume is the first in a series and contains theory as well as practical experimental projects. Included are chapters on oscillators, amplifiers, multipliers, antennas, transmission lines and other phases of communications systems. Soft-cover, 258 pages, $4.95

TROUBLESHOOTING AMATEUR RADIO EQUIPMENT (Howard Sams AMP-1) is another fine book by Howard Pyle. This is just the thing to have for field day or contests when some piece of gear quits. In addition to examining receiver, transmitter and antenna troubles it has a chapter on preventive maintenance. Soft-cover, 128 pages, $2.50

Want to be thoroughly versed in rf interference and its prevention? Read RF INTERFERENCE AND CONTROL HANDBOOK (Howard Sams RIC-1) by Barron Kemp. This text is a thorough study of the theory, measurement and methods of suppressing rf interference. Chapters include suppression in rotating machinery, ignition systems, teletype equipment and other equipment. Hard-cover, 224 pages, $6.95

AMATEUR RADIO ANTENNA HANDBOOK (Howard Sams AMA-1) by Harry Hooton is a comprehensive coverage of the theory and construction of amateur antennas and towers. It includes information on all of the types of antennas that the average amateur might consider erecting, plus chapters on propagation, transmission lines, impedance matching and antenna coupling systems. Soft-cover, 160 pages, $2.95

Letter

Wayne O.B. (Should be S.O.B.)

I have a photostat copy of your recent letter to a mutual friend inquiring as to my assistance in a specific program. This particular letter also outlined your desire to inform the individual all about my personal life since you were fully aware of my activities. Bully for you.

Your letter also revealed that I had stated to your attorney that you were a "gutter snipe" and that I threatened to assist in the cutting down of advertising in your imitation of a magazine. I do want to confirm that I did state you were a gutter snipe and in fact my limited vocabulary does not include any better description of one Wayne Green. I do not have to hear about you and your comments and nor do I have to read your writings. In fact, I can smell you all the way down in New York.

As to a cut down of advertising, need I say more? You already have felt the effects and I contemplate being fully successful in some day picking up your ridiculous publication only of course to find empty pages.

I guess that each fraternity has its' clown as in ham radio, you take the crown for being the clown. Perhaps someday you will grow up.

I hear rumors that you will finally become a WA1 or WB1. I presume the Call Letters could very well be WB1CHC. It could not happen to a nicer guy, I hope.

From your friend, of course,
you moronic slob,
Maxwell Meyers W2BIB

In Fig. 4, assume that R is the load to which it is desired to supply power from the constant ac voltage source e. From the relationship $P = i^2R$ it is seen that, for a fixed value of R, the larger i becomes the more power is supplied to R. The value of i is given by $i = \frac{R + j(X_L - X_C)}{e}$ where X_L is the reactance of the coil and X_C is the reactance of the capacitor. Since R and e were stated to be fixed values, i can be increased only by making the value of $(X_L - X_C)$ approach zero. $X_L = 2\pi fL$, where f is the frequency of the applied a.c. voltage and L is the inductance of the coil. $X_C = \frac{1}{2\pi fC}$ where f, again, is the frequency and C is the capacity of the capacitor. An examination of the formula for i shows that when $X_L = X_C$, the value $(X_L - X_C) = 0$, and i is at its maximum. The greater the difference between X_L and X_C, the smaller i becomes.

Now, let us return to the mobile antenna in Fig. 1. The inductace of the antenna rod is L in Fig. 3 and 4. The capacity to the car body is C, and R is the combined radiation resistance and loss resistances in the antenna rod and the car body.*

Suppose first that it is desired to operate the antenna at a frequency of 29 mc. From the discussion of series resonant circuits, we know that the current in the antenna should be as great as possible. Also, from a mechanical standpoint, we prefer to have the antenna as short as possible. With these two things in mind, suppose we try an antenna length of one foot. This is good mechanically, but we would find that the current in the antenna would be very small. The reason would be apparent if we could measure the inductive and capacitive reactances of the antenna. The inductive reactance would be small, and the capacitive reactance would be large. This is because the antenna is too short for the frequency involved.

It was pointed out in the discussion of series resonant circuits that for maximum current, the reactances must be equal. Therefore it becomes necessary to increase the inductive reactance or decrease the capacitive reactance, or both. It is quite easy to do both, simply by increasing the length of the antenna. The inductive reactance increases because of the increase in inductance. This is apparent from the formula $X_L = 2\pi fL$. This is similar to increasing the number of turns on a coil. Also,

* For good efficiency it is important that the radiation resistance be large as compared to the loss resistances. For a discussion of this point see the references given at the end of this article.

the increase in length increases the capacity between the antenna and the car body, and from the formula $X_C = \frac{1}{2\pi fC}$ we see that the result would be a decrease in X_C. This is similar to meshing the plates of a variable capacitor.

If we continued to lengthen the antenna we would find that at a length of about eight feet the reactances would be equal and the antenna current would be maximum. At this point we say the antenna is resonant.

In the foregoing example of an eight foot antenna for 29 mc, the length is quite feasible mechanically, and resonance was obtained without the use of a loading coil. However, let us now see what happens when we try to operate at a lower frequency, say 3.9 mc. If the eight foot antenna, resonant at 29 mc, were operated at 3.9 mc, much the same condition would exist as when we tried a one foot antenna at 29 mc; that is, the antenna current would be low, because the capacitive reactance would be high as compared to the inductive reactance. Therefore, we must again increase the length of the antenna if we wish it to be resonant at 3.9 mc. As the length is increased from eight feet, the inductive reactance increases and the capacitive reactance decreases, until at a length of about sixty-four feet they are equal, and the antenna current is again maximum. The antenna is now resonant, but an antenna sixty-four feet high mounted on an automobile is quite impractical mechanically, to say the least. The problem, therefore, is to make the eight foot antenna resonant at 3.9 mc without increasing its length.

In order to find a way to do this, let us first remember that by lengthening the antenna from eight to sixty-four feet we were trying to make the reactances equal. Now the capacitive reactance of the eight foot antenna cannot be decreased without increasing its length or in some other way increasing the capacity between the antenna and the car body. However, the inductive reactance can be increased so that it is equal to the existing capacitive reactance. This is done by inserting a coil in series with the antenna rod and adjusting its inductance so that the antenna is resonant. As stated earlier, resonance occurs when the reactances are equal, and this point can be indicated by a minimum reading of a Standing Wave Ratio Bridge connected at the input terminals of the antenna.

This is the "loading coil" which is so familiar in mobile installations. It is called a loading coil because it "loads" the antenna circuit with inductive reactance. This is necessary to balance out the capacitive reactance produced as a result of the antenna being shorter than the length required for resonance at the frequency of operation.

This is not the end of the mobile antenna story. We have only seen why a loading coil is used. There are many considerations necessary in the installation of an efficient mobile antenna system, such as the placement of the coil (bottom, center, top, or continuous loading), size of wire on the coil, and matching the antenna feedpoint impedance to that of the transmission line. It is not the purpose of this article to cover these items because they are discussed in detail in the ARRL *Mobile Manual* and *Antenna Book*. These publications are recommended to the reader who is interested in further information.

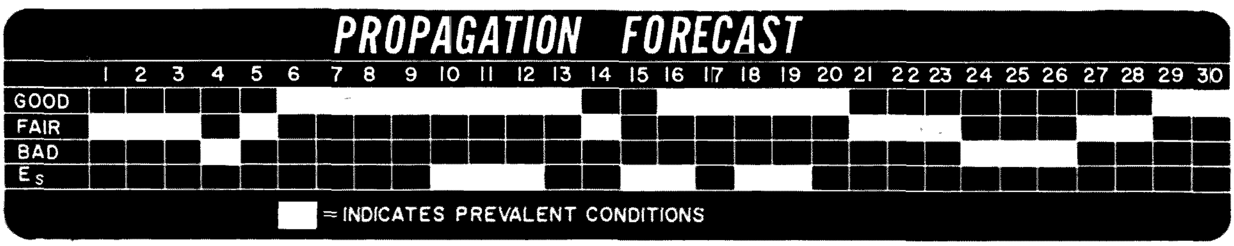
. . . W9GCQ

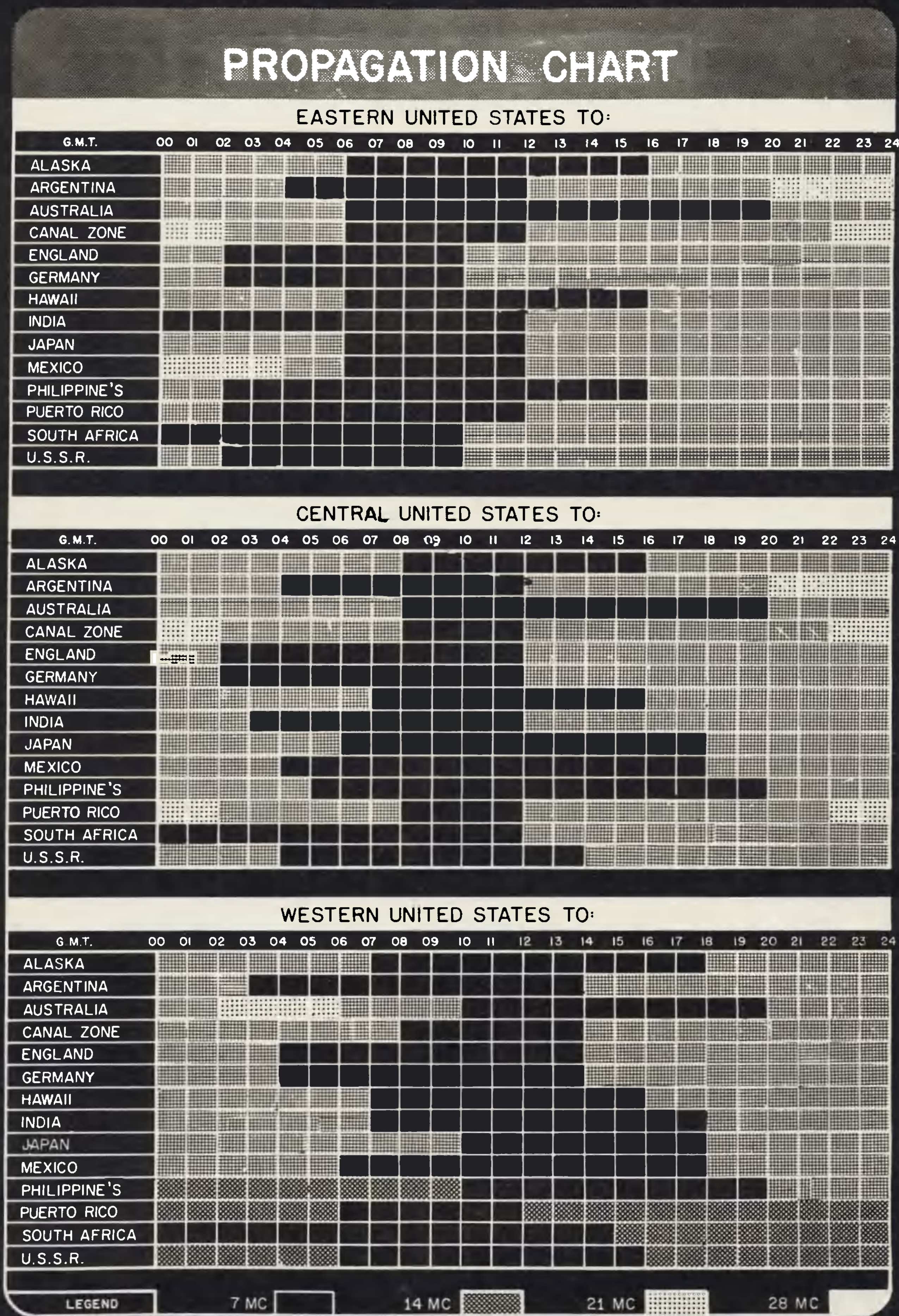
John Nelson

Propagation Charts

VHF Note:

Sporadic E is predicted for June 10-11-12, 15-16, and 18-19.
The 12th will probably be the strongest.




PROPAGATION CHART
EASTERN UNITED STATES TO:
CENTRAL UNITED STATES TO:
WESTERN UNITED STATES TO:
G.M.T.
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ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PUERTO RICO
SOUTH AFRICA
U.S.S.R.
LEGEND
7 MC
14 MC
21 MC
28 MC

More Selectivity for the Two'er

Dauph K6JCN

It is a well known fact that a superrengen receiver is sensitive. However, it is also extremely broad. Four or five signals will cover the entire two meter band.

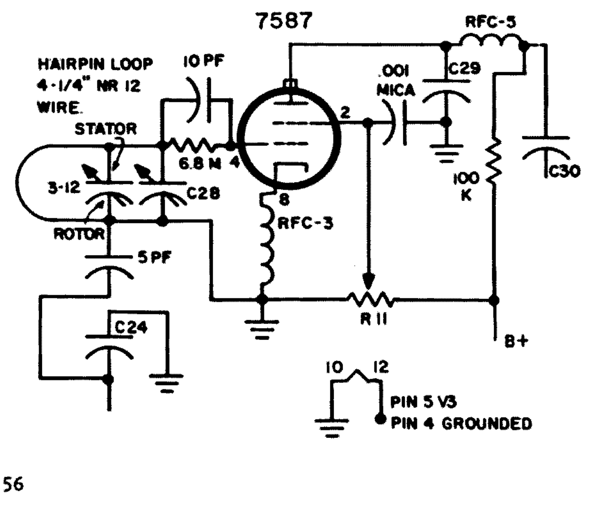
A receiver of this type can be made selective. In fact, the selectivity can be made almost equal to that of a superhet and with far less tubes.

Approximately thirteen years ago, experiments were made with a coaxial tank input circuit having a bandwidth sharp enough to receive two signals only 30 kc apart in the two meter band. The 6AK5 was the only tube found to work in this circuit.

An adaptation of this circuit was tried on the Heath Kit Two'er, just recently, and with excellent results. Two strong signals, less than 100 kc apart were copied without interference. Ever since the introduction of the Nuvistor Tetrode, I have been anxious to try it in this circuit. This tube has twice the gain-bandwidth of a 6AK5.

In order to modify the Two'er, remove L6 and enlarge the hole to accommodate the Nuvistor socket. Then, drill a small hole between RFC-5 and this hole. A plate lead should be brought through to the RFC-5. Next, change the 68K resistor (R12) to 100K and connect to the B plus side of the regen control. Next, bring a lead from the tie point that held the 68K resistor to pin 2 of the Nuvistor socket.

A .001 mfd mica capacitor is also connected to pin 2 and the other side grounded. The



RFC-3 is removed from pins 3 and 4 of V3B and connected to pin 8 of the Nuvistor socket. Pins 3 and 4 of V3B are now grounded.

Next, a lead from pin 5 of V3B is connected to pin 10 of the Nuvistor socket. Pin 12 is grounded. Remove R10 and C26. Remove lead from pin 1 of V3B. Pins 1 and 2 of V3B now have no connections.

A piece of #12 bus wire 4¼" long is formed into a hairpin loop and soldered to the stator prong furthest from the chassis. The other end is soldered to the rotor connector. A 5 mmfd capacitor is connected from pin 6 of V3A to the loop about 1" up from the rotor. If it is too far up, it will stop oscillation. Just short of this point is best.

The grid capacitor is connected from pin 4 of the Nuvistor socket to the loop. Depending on the amount of selectivity desired, the grid resistor will vary from 2.2 Meg to 7.4 Meg. The lower the value, the broader the bandwidth.

While 7.4 meg. gives the sharpest bandwidth, it also reduces the audio. This is characteristic of superregens. A good compromise would be 4.7 Meg.

The selectivity was increased by a factor of 5 and almost equals the selectivity of the Gonset #2. The sensitivity was measured at ½ micro volts. . . . K6JCN

Letters

Dear Wayne:

Although I am not in the habit of writing letters to an editor, I just couldn't resist this one after reading your editorial in the April Fool issue. The description of your subscription trials and tribulations was too close to home. We've gone through exactly the same miserable situation ourselves and know only too well what it is like to be on the receiving end of an irate subscriber's invective.

What really hurts, of course, is that by his lights he is

perfectly justified in complaining, for, regardless of whatever else, he has paid his money and he hasn't received his magazines. It is neither an excuse nor a justification to say the mess is the fault of the outside service house — even though it's true. And that's exactly why the situation is so infernally frustrating to everybody.

Before ending this letter, I would like to say that I enjoy 73 because it is a maverick, just like you are, and being your personal creation it is a reflection of your personality by extension. Perhaps I feel this way because of a tinge of envy. The magazine I edit is much more formal and restricted. Its audience, I'm afraid, would never see the humor in such things as the last line in your indicia.

Morton Waters W2JDL

CW Abbreviations

I goofed! Or more about the Phillips code, and stuff.

The magazine **Telegraph and Telephone Age**, the former publishers of the Phillips code book, has gone out of business. The code book is, however, available from Radio Bookshop, Peterborough, N. H. The price direct from them is $2.75 postpaid.

It is gratifying to note the interest in the Phillips code. It can be very useful. For example, how do you indicate a dollar sign in cw? Phillips code provides the answer "sx." "Lx" is pounds Sterling, and a simple hyphen is "hx" "gx" is "great excitement," like when zj8zz calls cq on 20 meters on a Sunday afternoon. Think of the effort saved when you just say "utc" for "under the circumstances," "itc" for "in this connection," or "ixu" for "it is understood." "qpt" is code for "on the part of the." You needn't know how to spell "conscientiously." Just use the Phillips code "kny" and let the receiving operator figure out how to spell it!

The Phillips code provides a uniformity not now evident in the jumble of abbreviations used on cw. With Phillips it is possible, "ixp", to get a 33 1/3% increase in cw speed. That means we could get 1/3 more cw boys on the air without increasing the qrm! No? A worthwhile accomplishment.

Perhaps Wayne Green will offer a "ccc" certificate for a "code chewers club" award. It could start with all former press operators as charter members with the usual buck for handling and administration thereof.

Harold Carlson K7MSL

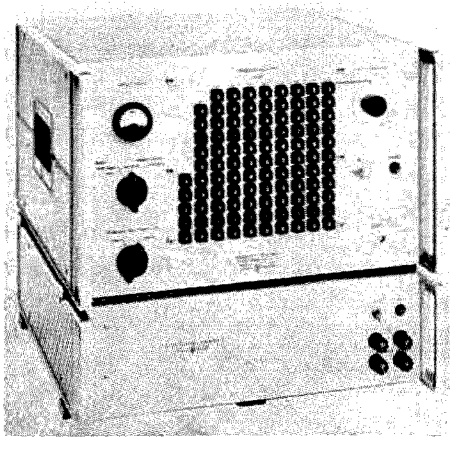
Dear Wayne:

No self-respecting ham should be without one of the Hewlett-Packard 5100A/5110A Frequency Synthesizers. Just imagine — no more xtals, no VFO's. Just press a few buttons and choose your frequency — in 0.01 cps steps. Up to 50 mc VHF-men could use two or three . . . and go up to 100 or 150 mc.

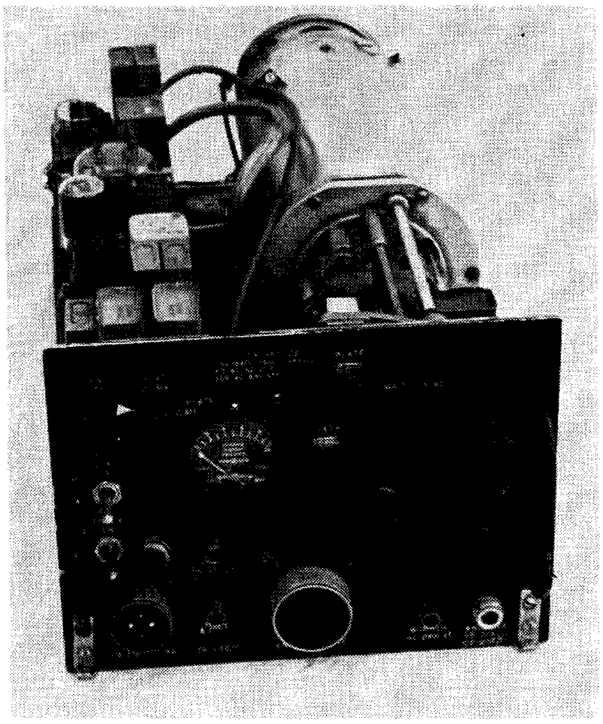
How about a 73 test report? Do you think the freq. stability of the unit would permit it to become popular with the novices?

Keep up the good work!

Ulo Vilms Ex-ES6E
11325 Stagg St.
Sun Valley, Calif.



Price:
$15,000.00



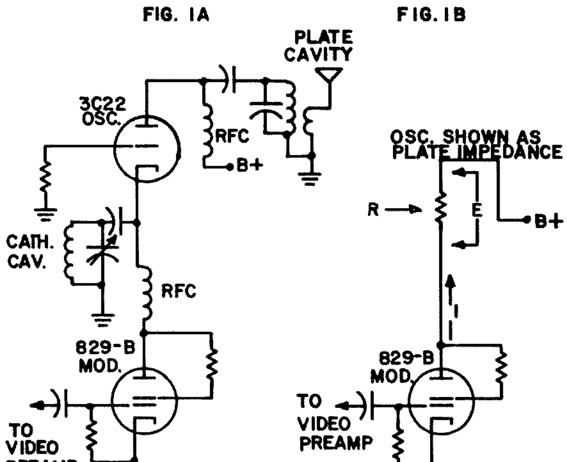
ART-26 Front view before the addition of 11 pin octal power plug.

Photos by Joe DeYoung WA6CQL

Amateur Television with the ART-26

Jim Kennedy K6MIO
Chuck Colby WA6BSL

The ART-26 is, in the rough, a small military video transmitter. The rf portion of this transmitter uses a 3C22 lighthouse triode as a self-excited oscillator-final in a coaxial cavity circuit. This cavity is a ruggedly constructed assembly which contains tunable coaxial lines which tune the plate and cathode circuits separately. These are connected to a gear drive and counter system that makes it possible to tune the plate and cathode line together or the cathode line alone by merely pulling out on the tuning knob. Two counters on the plate and cathode gear drives have over 2000 digits over the tuning range of 300-600 mc. This represents an average of 6.7 digits per megacycle. There is also a tuning knob lock.

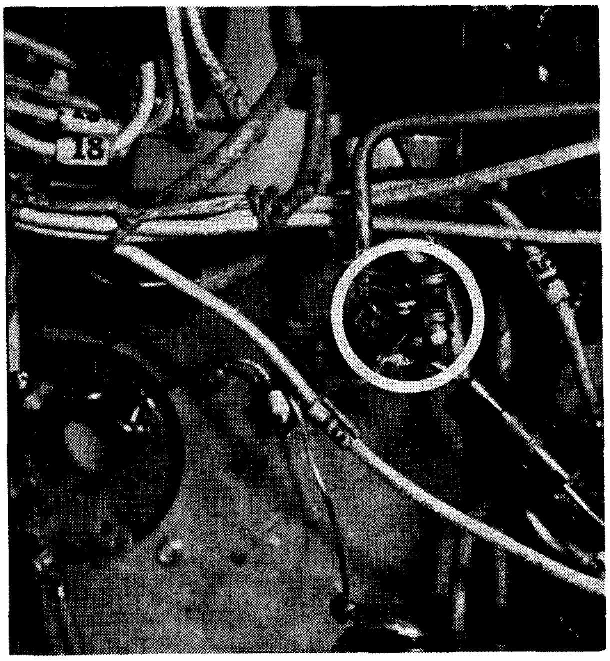


a) Simplified circuit of the ART-26 series type plate video modulator
b) Series plate video modulator with modulated stage shown as resistor equal to plate impedance of that stage.

Electrically the oscillator cavity assembly represents two concertrically arranged one quarter wave length coaxial lines. In this type of oscillator the plate cavity primarily determines the frequency and the cathode cavity is then tuned for maximum output. The stability of this oscillator is very good considering the band widths involved. The resetability precision is also very good.

The Modulator

The modulator is a bit unusual for the power of the transmitter and is deserving of comment. When attempting to modulate a TV transmitter whose input is much greater than the dual 6AF4 class, the type of modulation employed is, generally, some type of grid modulation.



L shaped metal tube in upper left quarter of photo contains oscillator grid lead, circled is the added by-pass capacitor.

This system has the advantage of requiring relatively small tubes to modulate rather high powered stages. There is, however, one serious disadvantage and that is the low transmitter efficiency inherently brought on by grid modulation.

The ART-26, however, does not employ grid modulation. It employs a series type plate modulator which operates very effectively and enables the transmitter to operate at full efficiency; at least twice that of the same transmitter employing grid modulation.

Fig. 1a shows a simplified diagram of this type of modulator. The oscillator circuit is shown in its lumped constant equivalent. As can be seen in the diagram the oscillator final is actually in series with the modulator tube. Any current that the final draws must flow through the modulator tube and conversely any current drawn by the modulator tube must flow through the final. Now, if a video voltage is applied to the grid of the modulator, it will not only control the modulator current but it will necessarily also control the final current as they are one and the same.

It will be noted in Fig. 1b that the voltage E across the plate impedance R of the modulated stage varies in direct proportion to the modulator plate current I; or E=IR. It will also be noted that the modulator plate current I is directly proportional to the video voltage at the grid of the modulator. Therefore, as E and I are directly proportional to each other and to the video driving voltage, the power consumed by the resistor R is equal to (E × I) and is directly proportional to the square of the video driving voltage. This is the necessary condition for linear amplitude modulation and, as has been proven, this condition is met. Of course, in practice not all the power is turned into heat as it would be in a resistor. Happily some of this power is delivered to the antenna and makes this whole project worth while.

It should be noted that when this type of modulation is used the average plate to cathode voltage of the final is about one half of the applied B+. It is this voltage that is used when computing the input power of the transmitter. When an 800 v B+ is used it will be found that a dc voltmeter connected between the plate of the 3C22 and the plate of the 829-B modulator (same as 3C22 cathode, see Fig. 1a) will read about 500 volts. This voltage times plate current represents the average input of the transmitter.

The Conversion

The conversion is simple. The original power supply was designed for 800 cps operation, so it is useless to the amateur. The transmitter requires 800 vdc at 100 ma, 400 vdc 100 ma, 24 vdc at 1.5 amps and 120 vac. A power supply must be constructed to meet these require-

ments. The only modifications which must be made to the transmitter are the following:

There is a 800 cps filament transformer located in front of the cavity assembly on that subchassis. This transformer supplied 5 vac at 2 amps for the 5V4, 6 vac at 2 amps, for the 3C22 and 6 vac at 8 amps for the modulator assembly. This transformer must, of course, be removed for 60 cps operation. In the space occupied by this transformer, filament transformers supplying 6 vac at 2 amps and 6 vac at 4 amps should be placed. The space available will easily accommodate two transformers.

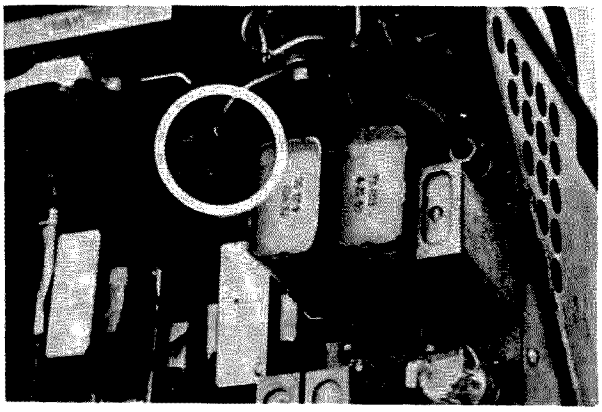
To remove the transformer, turn the transmitter over and you will find a removable bottom cover on the rf subassembly. Twist the two screws and lift off the plate. You should find that the leads connected to the transformer pins are numbered, as are most of the other cables. The same numbering system seems to have been used in most units, so the numbers given here will probably apply, but look the situation over first to be sure. Unsolder the leads and remove the old transformer.

Mount the two new transformers in place of the old one and connect the 120 vac primarys of each to leads Nos. 18, 19 and 21, 4. 18 and 19 should be connected together and 21 and 4 should likewise be connected together. Each of these junctions represents one leg of the 120 vac.

Connect one leg of the 6 vac at 4 amps to the chassis and the other leg to leads Nos. 20 and 26.

The 6 vac at 2 amps is connected to leads Nos. 13 and 15. These supply the 3C22. It is absolutely essential that the 6 vac supply for the 3C22 not be grounded and must be completely independent, that is, there must be no other tubes on the 6 volt side of the circuit. No attempt should be made to supply the 3C22 from any source common to other tubes because the cathode of the 3C22 is about 600 vdc hot to ground and such a connection would either destroy the 3C22 or the other tubes on the 6 volt circuit. This 6 volt transformer should have at least 800 vdc insulation.

You will find that all the old transformer leads are now accounted for except two short, heavily insulated leads which go directly to the 5V4 socket nearby. This tube has been eliminated for reasons explained later. Remove the lead that goes to pin 8. Bend the lead that goes to pin 2 back and connect it to pin 6. Be sure that pin 2 is the pin that also has a lead going to the coil on the top of the chassis next to the tube socket. If it is not, then pin 8 is, and pin 8 should be connected to pin 6 instead.



Two transformers on the bottom are in parallel to supply 6 vac @ 4 amps, "piggy back" transformer supplies filament power for 3C22. Circled is the meter series resistor and the resistor added to correct its value for the new meter.

There is a time delay relay (6-NO 110) socket located near the filament transformer. This relay was an "idiot proofing" device which operated a 24 vdc relay located under the bottom cover of the oscillator assembly and made it impossible to apply voltage to the plate of the 3C22 for 110 seconds after the filaments had been turned on. You may keep this feature if you wish, but, if for no other reason but the cost of the relay, I suggest that the system be eliminated. Most of us are accustomed to letting the filaments warm up before trying to turn on the carrier.

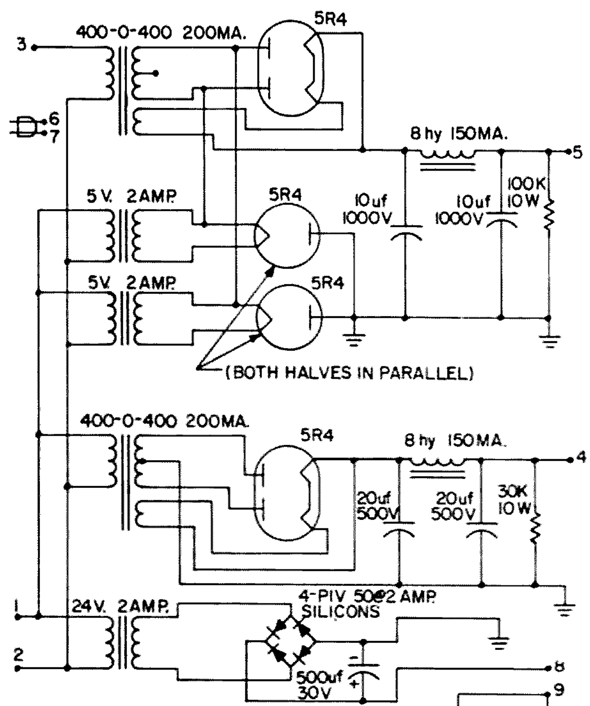
Toward the rear of the underside of the unit you will find the 24 vdc relay mentioned. Remove lead No. 4 from the switching contact and solder it to lead No. 3 on the normally open contact. In the middle of the bottom near this relay you will find a small terminal board. On one of the terminals you will find a lead No. 5; remove it and tape it up. You have now eliminated and disabled the relay.

The large ten pin plug on the front panel is difficult to replace cheaply and it is therefore advisable to eliminate it this way. Remove the modulator subchassis (screws on the bottom). This allows easy access to the four pin plug marked POWER. The leads should be unsoldered from the POWER plug and the plug removed. In its place an eleven pin octal male plug should be placed. This will now become the plug to supply all the voltages. The leads on the large ten pin plug on the front panel should be carefully removed one by one and new wires about six inches long spliced to those that will be used. You will find that it is not necessary to remove all these leads as some are not used. These wires are run along the cable harness to the newly installed power plug. Leads Nos. 12, 18, 9, 10 and 7 should be spliced (these wires were removed from pins Nos. A, G, J, H, and M, respectively). Lead No. 7 carries the 800 vdc and should be insulated accordingly. These leads are connected to pins 1, 2, 3, 4, and 5 respectively on the new plug. Leads No. 17 and 19 (removed from the old POWER plug) are connected to pins Nos. 6 and 7. Lead No. 23 (old POWER plug) is connected to pin No. 8 and the ground lead (old POWER plug) is connected to pins 9 and 10.

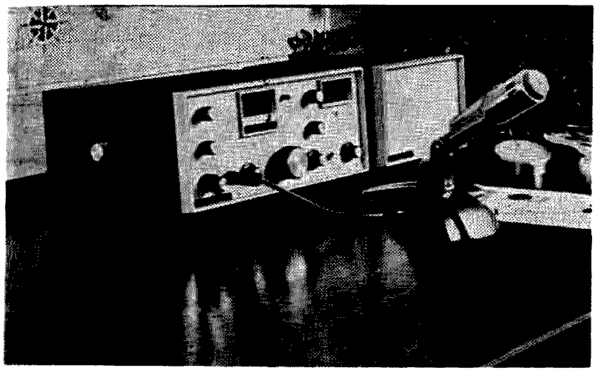
We have also found that some additional by-passing of the oscillator grid will increase the output of the transmitter. This may not apply to all units but it will probably make a substantial difference in most. In one unit tested, it increased the output power by about four times.

In the underside of the rf section there is a one terminal tie point which was held in place by one of the mounting bolts on the old filament transformer. There is a lead attached to this tie point which runs through a small metal tube which acts as shielding. This tube runs through the chassis to the cavity and is the grid lead of the 3C22. At the tie point I mentioned add a 25 mmfd capacitor from the metal tube to the tie point. This should supply all the bypassing needed. Much higher values will seriously effect the video.

FIG. 2



Suggested power supply. Numbers on leads refer to pins on the power plug. Tube location chart (top view).

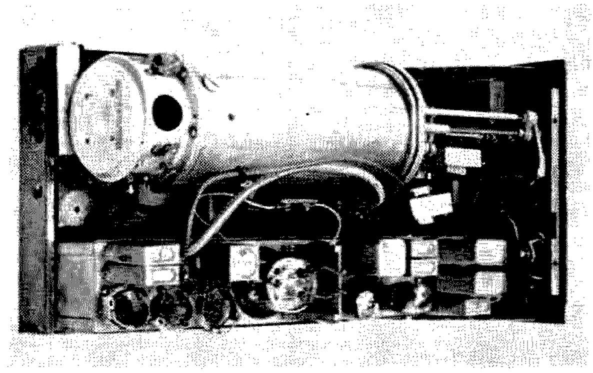


This completes the transmitter modification.

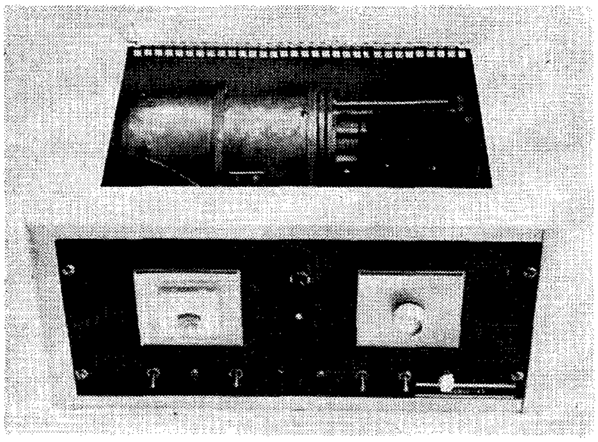
The transmitter has a separate sync modulator. This apparently was designed to accept the separate sync pulse provided by such cameras as the ATJ-ATK. However, it has been our experience with the several units we have tested that the sync output of this special modulator is actually inferior to the pulse obtained by merely coupling a little of the camera's sync into the video through a small capacitor in the camera. The resulting composite signal (video, blanking and sync) is fed into the plug on the front panel marked, VIDEO & SYNC. The SYNC only plug is not used. The tubes in the sync modulator are merely left out. This reduces the filament drain, as well as pocket book drain. The sync tubes, two 6AR6's and a 6SN7 are shown in Fig. 3 merely for sake of completeness. The 5V4 is also a part of this system and is likewise not used and may be left out.

The Power Supply

Now it is necessary to construct a power supply to provide the 800 vdc at 100 ma, 400 vdc at 100 ma and 24 vdc at 1.5 amps. Fig. 2 shows a typical supply. T1 and T2 are TV set power transformers. These may often be obtained very cheaply from junked sets in junk yards and dumps. We have got them for as little as 50c. These transformers generally have ratings in the neighborhood of 400-0-400 at 200 ma and will easily handle the job. T1 is used in a standard bridge circuit to obtain 800 vdc. This plate supply is turned on by applying ac to the primary. This is done by the HI VOLTAGE ON switch in the transmitter. In the circuit shown the filaments of one of the rectifiers come on simultaneously with the high voltage. This will not hurt anything, but if you are feeling rich you can pick up another



ART 26 Top view, note empty tube sockets to rear of modulator chassis.



WA6BSL preferred to put the unit in a surplus cabinet and remote the switches to the front panel. Extra switches are for changing cameras.

filament transformer and all the filaments in the rectifiers will stay on.

The 400 vdc supply is a conventional full wave supply. The 24 vdc supply is for the blower.

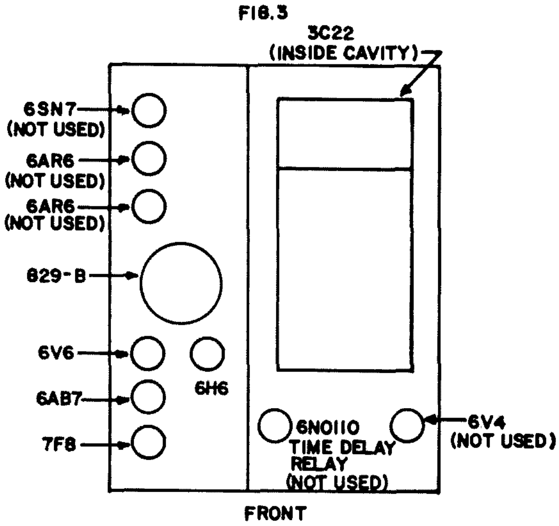
It will be noticed that all the switching for power is handled remotely by the two switches on the transmitter.

All the units we have encountered have had the front panel meter pirated. This meter may be replaced by any 0-1 ma meter but it may be necessary to alter the series value to suit the particular meter you use. This resistor is located on the end of one of the meter leads and may be a wirewound or two compositions in parallel.

Tuning Up

Now that you have your power supply and transmitter ready, plug in the tubes. When inserting the 3C22 it will be noticed that the phenolic cover that bolts over the plate fins

FIG.3



has a pointed screw and lock nut. Loosen the lock nut before you bolt this disc back in place.

When the tube is in place and the disc bolted down, look through the large air hole in the cavity. Tighten the screw until you can see that the plate seal of the tube is snuggly pressed against the plate contact ring. Don't force it. When it is snuggly pressed tighten the lock nut.

Next you need a pair of Lecher wires.[1] Plug a type N connector with a small loop on it into the ANTENNA plug. This is used to couple energy into the Lecher wires. Set the wires at 33.8 cm if you wish to be on 445 mc. Use the formula in ARRL Handbook to find the half wave length for other frequencies.

Set the Plate and Cathode counters at about 2420. Put the meter switch in the ANT. OUTPUT position or put a small loop on a 3 volt lamp and put it close to the antenna loop.

Picture as it appears at WA6BSL's QTH five miles away. Camera used is a sick ATJ. Picture is a modified travel poster.

Connect the power supply to the transmitter and turn on the POWER switch. Wait two minutes and turn on the HIGH VOLTAGE switch. The lamp should light up indicating output and the ANT. OUTPUT meter should give some indications. Now, couple in the Lecher wires to the antenna loop. Tune the Plate and Cathode simultaneously for maximum indication on the indicator on the Lecher wires. This should put you on frequency. Now, pull out on TUNING knob and tune the cathode alone for maximum output and tighten the tuning lock.

If you have a video monitor connect it to the MONITOR plug on the front panel. The video is obtained from a diode probe in the transmission line.

Now plug in your camera or scanner to the

[1] See the Radio Amateur's Handbook.

(Turn to page 121)

Special

Surplus Catalog

As a youngster in New York, I spent a great deal of my Saturdays picking through the bargain counters of Cortlandt Street and Wholesale Radio up on Sixth Avenue, carefully apportioning my week's lunch money to net me the maximum number of parts.

The amazing bargains of the 30's were nothing compared to the bonanza that hit us after The War. The ham who liked to tinker could almost go out of his mind while going through the fantastic surplus houses that sprang up.

My barn here is not too mute testimony to the number of bargains that I have been exposed to. The collection is impressive and I regret not one 19c pot. My only sadness is that back in the first flush of surplus my almost non-existent budget while going to school made me miss a lot of beautiful gear. Sigh.

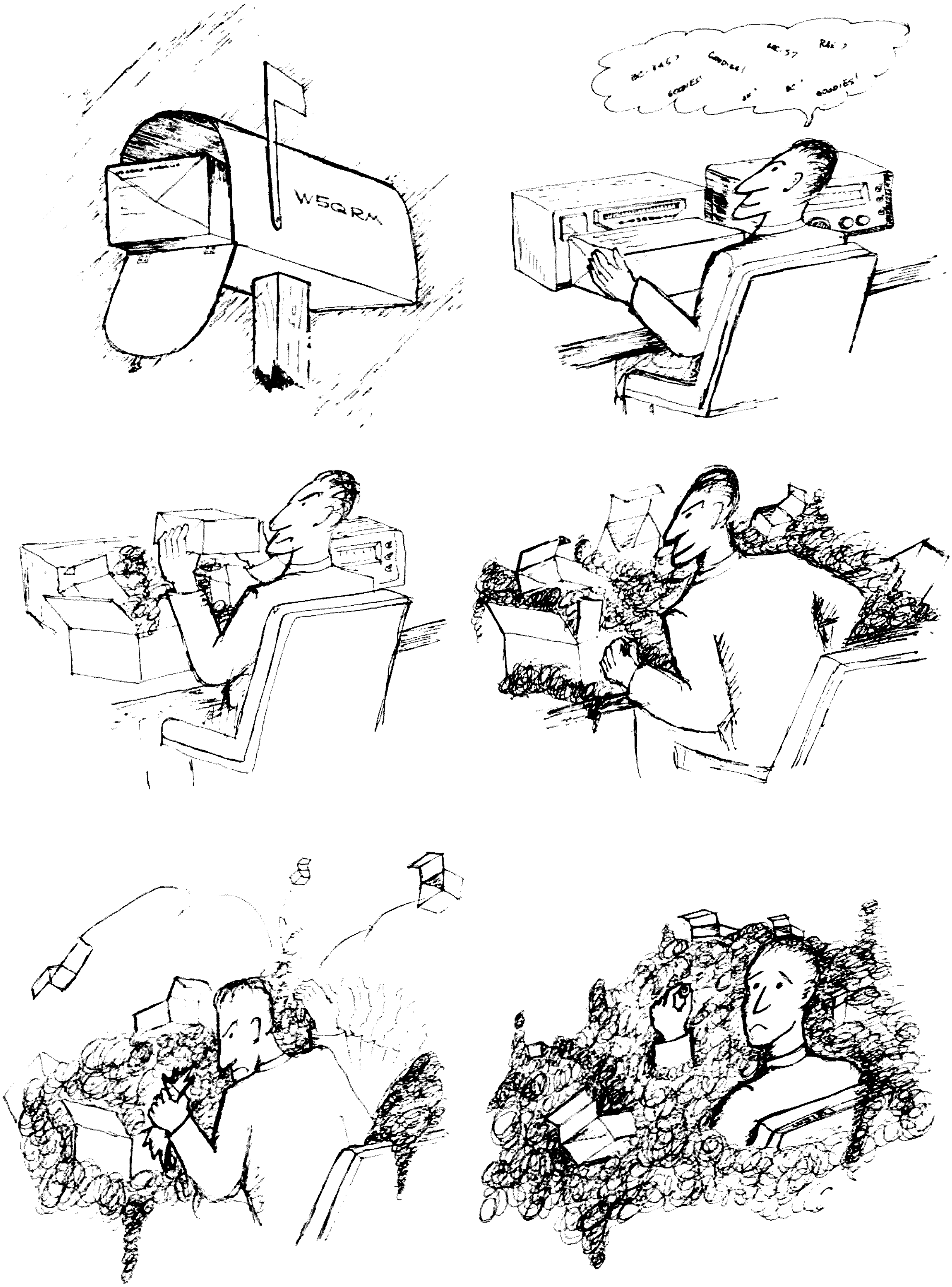
One thing got my goat though. Maybe you noticed that there was very little Navy surplus around? Well, I did! And I thought I knew why. Let me set the scene for you.

My habit of accumulating things to fit whatever storage facilities are at hand was not disturbed by the War. When I reported aboard the U.S.S. Drum in 1943 at Pearl Harbor I was assigned a small locker for clothes and personal use. It was about 18" x 12" x 12". A year and a half later I had taken over most of the storage space on the submarine and when I finally was transferred to a teaching job back at the Submarine School in New London they were incredulous as I shipped home fourteen seabags and twelve large spare parts boxes of stuff. To the best of my knowledge I was the only ET in the Navy who had a radar repeater mounted in his sack so he could keep track of what was going on while off duty. Built it myself.

While teaching radio at New London I was greatly distraught to find that they were busy destroying millions of dollars worth of radio equipment. The story I got from a Texas ham who was in charge of the operation was that with the end of the war they found themselves with a warehouse full of radio and test equipment which had been supplied to go aboard submarines that were under construction. The construction was stopped on the subs, leaving all that beautiful gear sitting there with no place to go. So they chopped it up and crushed it into scrap. Navy men repeated similar tales of destruction on many other Navy bases. There is something unforgettable about watching a few dozen Dumont scopes being unpacked brand new from the factory and being chopped to bits, followed by a truckload of National receivers. SOB.

Luckily the Army released most of their gear through the surplus channels . . . and is still doing it. Today you have to do a lot of travel if you want to pick over the surplus counters for they are spread all over the place . . . Boston, New York, Philadelphia, Chicago, Cleveland, and Southern California. Or else you can take your pencil in hand and pour over the following pages of Surplus Catalog. As far as I know, nothing like this has ever appeared in a magazine before. If you like the idea we can do this once a year.

. . . Wayne



Surplus Package

Bill Moore W5IMJ/5

A Bargain Receiver for 220

the R-48/TRC-8

Bert Soltoff K3IUV
8582 Benton Avenue
Philadelphia 15, Pennsylvania

If you are contemplating the purchase of an item of surplus equipment it should satisfy one of two requirements. The first is that it should be readily adaptable with minor changes to the intended application. If it does not meet the first requirement, then consider its purchase only if it contains a large assortment of useable parts. If it does not meet either of these requirements forget it, as your garage or basement is probably well stocked with useless parts already.

A piece of surplus equipment that meets the first requirement is the R-48/TRC-8 receiver. This receiver is available at a very moderate price, and represents an excellent investment. Originally intended as an FM receiver covering the range from 230 to 250 mc, this receiver can provide excellent performance on the 220 mc band. Don't let the FM part discourage you—read on. The receiver contains a built in 110 v 60 cycle power supply, a low pass filter in the audio amplifier (3 kc cutoff), a built in speaker, a separate 500 ohm audio line amplifier, metering of the individual plate current of each of the stages, and the use of tuned lines for the front end of the receiver.

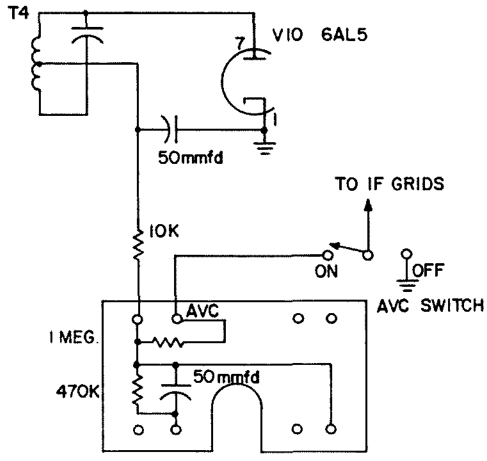


FIG. 1

What are the drawbacks? Well for one thing, the FM detector is useless for our purposes since 95% of the 220 activity today is AM (the other 5% is SSB and CW). Another drawback is the tuning range of 230 to 250 mc. This is no real problem since it is a simple matter to move this range down to 220 mc. The third drawback is that the *if* bandwidth is rather broad as compared to the normal communications receivers that we are accustomed to using. But this is actually a blessing in disguise. If you use this receiver for net operation, the normal problems associated with stations off frequency by a few kc will never be noticed. While the signal/noise ratio is degraded slightly by the wide *if* bandwidth, the built in audio filter compensates for it by eliminating the higher frequency noise background that masks weak signals. Fourth drawback—no AVC. Here again no problem as it is easily added. The original receiver included a squelch circuit, however, the squelch is operative on FM only and in converting to AM the squelch action is lost. If you wish to include a squelch in your converted receiver it is easy to do so. The well known TNS circuit functions admirably in the receiver and provides noise limiting as well. If you are convinced of the virtues of the receiver by now, I will present a step by step description of the conversion. There are three basic parts to the conversion. First is changing the tuning range. Second is converting from FM to AM. Third is adding the squelch if desired. Ready? Grab your soldering iron and let's go.

Front End Conversion

1. Remove bottom cover from tuning gang.
2. Mount small solder lugs on rf and mixer gang just like the one already on the oscillator gang.
3. Solder 3.3 mmfd ceramic capacitors

from the two lugs to ground and replace cover on the tuning gang.

4. Set the meter switch on the "1st lim I_g"; set the tuning dial on 230 (now corresponds to 220) and peak osc, rf and mixer trimmers for max meter reading, using a signal gen on 220 or an 8150.0 crystal in your exciter.

FM to AM Conversion

1. Carefully remove T4 (orig discrim) from chassis. Clip R99 & R100 (15K) & C69 (100 mmfd) from inside T4. Remount T4.
2. Remove V8 and V9 (limiters—no longer needed).
3. Remove R36 (4.7K) from pin 1 of V8 and run short wire from pin 1 of V8 to term on T4 that came from pin 5 of V9.
4. Ground other end of primary of T4.
5. Connect pin 7 of V10 to either end of secondary of T4.
6. Remove all components (not wires) on term board on V10 subchassis.
7. Add 50 mmfd from centertap of T4 to pin 1 of V10.
8. Add 10K from centertap of T4 to terminal lug shown in Fig. 1.
9. From end of 10K, add 1 meg to terminal lug, 50 mmfd to ground, 470K to ground, and jumper to other lug (wire from C79).
10. On orig. squelch switch; on side that uses all three terminals of switch, ground black wire. On opposite end of same half of switch, remove existing wire and replace with a wire to end of the 1 meg added in step 9.
11. On other pole of the same switch, move wire from center term. to unused outer term. to disable the orig squelch relay. This switch now functions as an AVC on-off switch.
12. Remove and gnd black wire at the junction of R14 and R12. This removes the AVC from the rf amplifier.
13. Short R87 (560 ohms) on bottom volume control.
14. Place meter switch in *if* position where

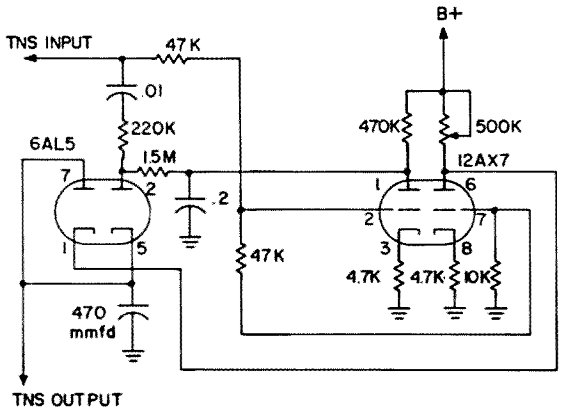


FIG. 2

it will function as a backwards S meter and tune T4 and L14 for max indication using same signal source as before.

The basic conversion is now complete and you should be able to hear signals on the air if there is any 220 activity. You may wish to peak up all the *if's* on a signal once you have the receiver operating. This is easily done by observing the meter in the *if* position and tune for maximum downward deflection of the meter. Be sure the AVC switch is in the on position. If you now desire to add the TNS circuit, you can either assemble the parts on a little subchassis, or buy a printed circuit board for it. The printed circuit board is available from Irving Electronics and is well worth the dollar it costs. To install it, proceed as follows.

Addition of TNS

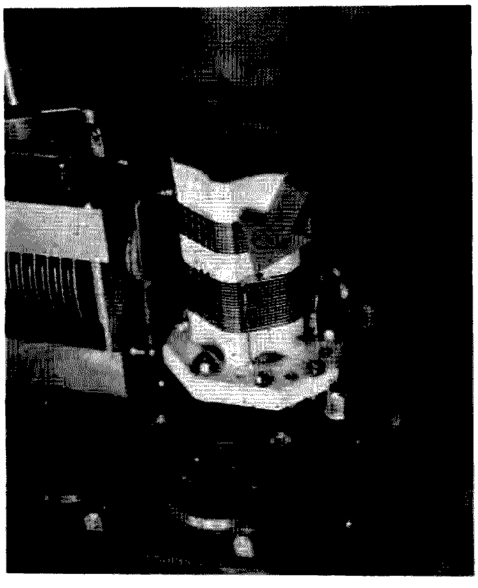
1. Obtain TNS circuit board or subchassis and mount the components on it.
2. Remove L16.
3. Attach wires to the TNS circuit as required and use spacers to mount it to the side of the receiver, above chassis.
4. Route wires through hole left by L16.
5. Remove original squelch pot-tuck out of way with leads on.
6. Mount new squelch pot (500K).
7. Remove 470K and wire jumper previously added on termboard and connect TNS input to their junction.
8. Connect output of TNS to where end of wire jumper went.
9. Connect filament lead of TNS to pin 3 of V8.
10. Connect B+ lead of TNS to red wires on terminal strip.
11. Connect pot leads of TNS to the new squelch pot.

Fig. 2 shows the schematic of the TNS circuitry. This squelch circuit is very effective, and if the majority of activity on the band in your area is on one frequency you can use the receiver to monitor that frequency while operating on another band. Since no background noise is present when the squelch is on, the receiver does not interfere with your other operations. About thirty of these receivers were modified in the Phila. area, and all are operating satisfactorily. The performance is quite good and many checks have been made by switching back and forth between this receiver and a low noise converter feeding a communications receiver with very little difference in receiving capability being observed. Incidentally, when you purchase the receiver be sure you get the schematic diagram which is printed on a metal plate and screwed inside the shipping cases. Hope to hear YOU on 220 soon. . . . K3IUV

Three for the ARC

Frank Benzon W7ATK
Route 2, Box 66
Burton, Washington

For some of us it's a sobering thought that there are hams on the air today with SCR274/ARC-5 gear who are too young to remember when command sets were new on the surplus



If you do any coil-pruning don't forget to bring some of the turns to the top of the coil form to keep the slug effective. The arrow indicates the grid tap.

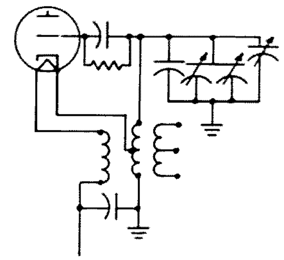


FIG. I
ORIGINAL

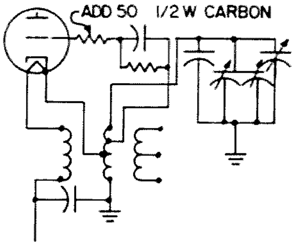


FIG 2

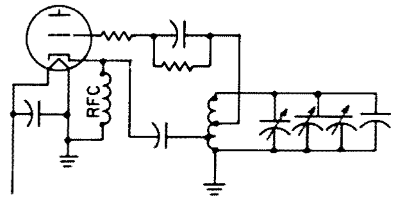


FIG 3

market, and let's not dwell on it. However, the ubiquity of this equipment after so many years is a real tribute to the men who designed it, and the number of operational units still on hand probably is exceeded only by the number of articles written about it.

By now it isn't likely that any reasonable modification of the command transmitters will be new to everybody, but if you haven't yet worked one over, you will find these suggestions helpful in improving the stability of the oscillator.

Fig. 1 is the original circuit with the grid connected to the top of the coil and both sides of the filament above ground for rf. In Fig. 2 the grid is tapped down on the coil to reduce the loading and improve circuit Q. At this point a fifty ohm carbon resistor should be added in series with the grid to prevent parasitics. In Fig. 3 the oscillator has been changed to a 6AG7 and the cathode current eliminated from the coil by adding a .001 silver mica blocking condenser and grounding the cathode through a 2.5 mh rf choke.

These modifications were preliminary steps in turning a 2.1 mc to 3.0 mc ARC-5 into a VFO and provided the extra stability requisite for sideband. Specifically to spread the 2.5 mc to 3.0 mc range for calibration convenience

the coil was trimmed to twenty seven and one half turns, with the cathode tapped at the ninth turn and the grid tapped at the seventeenth turn from the bottom. For eighty the output is mixed with a 1 mc crystal oscillator, for forty with 4.5 mc and for twenty with 11.5 mc. Of course the purpose of this heterodyning is to extend the level-headed virtues of three megacycles to the upper bands, and the coil pruning data is supplied in the event that this approach interests you. Should you prefer trying eighty or forty with another unit of the series, and without voiding the warranty unnecessarily, tapping the grid down, adding a parasitic-choker and separating the coil and the cathode current will help an old friend do a good job.

. . . W7ATK

The AN/ARC-5 Command Receivers

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

The AN/ARC-5 Command Set Receivers are widely available on the surplus market and, for sheer utility, they cannot be equaled at the going prices. Although more has been written on the Command Set receivers [1] than on any other surplus electronic equipment, there is a distinct lack of information on the AN/ARC-5 version.

Many published articles on the Command Set receivers describe an application or conversion of the SCR-274-N components and then wind up with the statement that the instructions are generally applicable to the AN/ARC-5 equivalent. Let's face it—the AN/ARC-5 is different. Also, the AN/ARC-5 receivers are better in several respects. Increased audio output in the navigational receivers and the inclusion of AVC in all models are two of the significant improvements. Wiring in many models is improved by use of plastic insulated wire. Also, the black crackle finish of the AN/ARC-5 components is a distinct improvement over the bare aluminum used in many of the SCR-274-N models.

To provide a ready reference, a brief rundown on the characteristics of the AN/ARC-5 Command Set receivers is in order:

These units, along with the SCR-274-N receivers, all have certain features in common. All were designed for operation from a 24 volt dc aircraft power system and contained a dynamotor to supply the required plate voltage. All units were designed for remote operation and so no tuning knob, rf gain control, BFO or power switch were provided. All the receivers are equipped with a rear-chassis connector which established power and control connections when installed in the aircraft equipment mounting racks. In addition, most of these terminations are duplicated at a recessed front panel connector. This cutout was normally filled with a blank remote control adaptor panel although various special purpose adaptor panels are available. Among these is the type C-24/ARC-5 local control unit.

It is impossible to list, in the available space, all amateur uses of the Command Set receivers or to describe any conversion in detail. These units have been used for everything from Novice receivers to *if* elements in successful amateur moon-bounce experiments. The basic conversion consists of installing a tuning knob and the C-24/ARC-5 local control unit or home-brew

				Selectivity**			
Type	Frequency Coverage	*IF* Frequency	Sensitivity*	6 db	20 db	40 db	60 db
R-23/ARC-5	19 - 550 kc	85 kc	5 μv	2.2	4.4	6.6	9
R-24/ARC-5	.52 - 1.5 mc	239 kc	7 μv	4.2	8	12	16
R-25/ARC-5	1.5 - 3.0 mc	705 kc	7 μv	6.4	12	18	26
R-26/ARC-5	3.0 - 6.0 mc	1.415 mc	6 μv	14.6	26	38	52
R-27/ARC-5	6.0 - 9.1 mc	2.830 mc	6 μv	26	52	80	112

* Signal level in microvolts, modulated 30% at 400 cycles, required to produce 10 mw audio power into a matched 300 ohm load.

** Selectivity is defined as the separation in kilocycles of the two points on the overall rf-*if* response curve where the signal level is down the specified amount.

1 "Index to Surplus," available from 73 Magazine for $1.50, lists 82 articles on Command Set receivers that have been published since 1946.

equivalent. A phone jack and connection of 28 volts ac and B+ to the back connector completes the job.

The high frequency units may be used as complete amateur band receivers and the low frequency navigation receiver works wonders in the famous "Q5-er" application. In this use, the antenna of the Command Set receiver is coupled to the last *if* stage of the normal station receiver and tuned to the *if* frequency. The greatly increased selectivity of this outboard unit will improve the performance of older or less expensive current production receivers. The reference lists a host of magazine articles citing numerous other applications along with full conversion details.

This just scratches the surface. Accumulate the references, buy a receiver, and dig in. You can scarcely go wrong and nowhere can you get so much performance, along with practical experience, for so little money. . . . W4WKM

Letters

Dear Wayne,

I dropped my subscription to CQ because of the OLD MAN. I can't see how he turns out so much garbage on a "part-time" basis. The following may be interesting to Apache-SB-10 owners: I've found out that I get a little better operation and a lot cooler transmitter when I use a separate power supply for the SB-10. The 140 ma voice peaks are quite a strain on the Apache.

. . . Neil Lilien K2MRB

Dear Wayne,

Here is an idea for converting 6-volt car radios to twelve volt operation. The conventional method is to use a ballast resistor in series with the radio. My approach is to use the filaments themselves for the series resistor, and to connect the vibrator supply in series with the paralleled filaments. The average set draws two amperes in the vibrator supply and two in the filament supply. This makes them draw close to six volts when connected in series, and no current is wasted on a ballast resistor, hence, total power drain is less.

. . . Lee Tomes K1IFK

Dear Wayne,

Many thanks for the excellent article "432 mc Gallon" by K2TKN. However a word of caution should be exercised by all amateurs when experimenting with high power in the UHF region.

Since the low end of the microwave region (300-1000 mc) has the deepest penetration of the skin, it can destroy or damage internal living organs of the body with prolonged exposure. Power outputs of 200 watts or more at 400 mc can be dangerous if not handled properly.

. . . Arnold J. Carmody K2BZC

Hey, wait'll you take a look in my new 420 mc slot antenna!

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Conversion of the T-67/ARC-3 to a Table Top, Home Station Transmitter.

Still Another 2 Meter Conversion

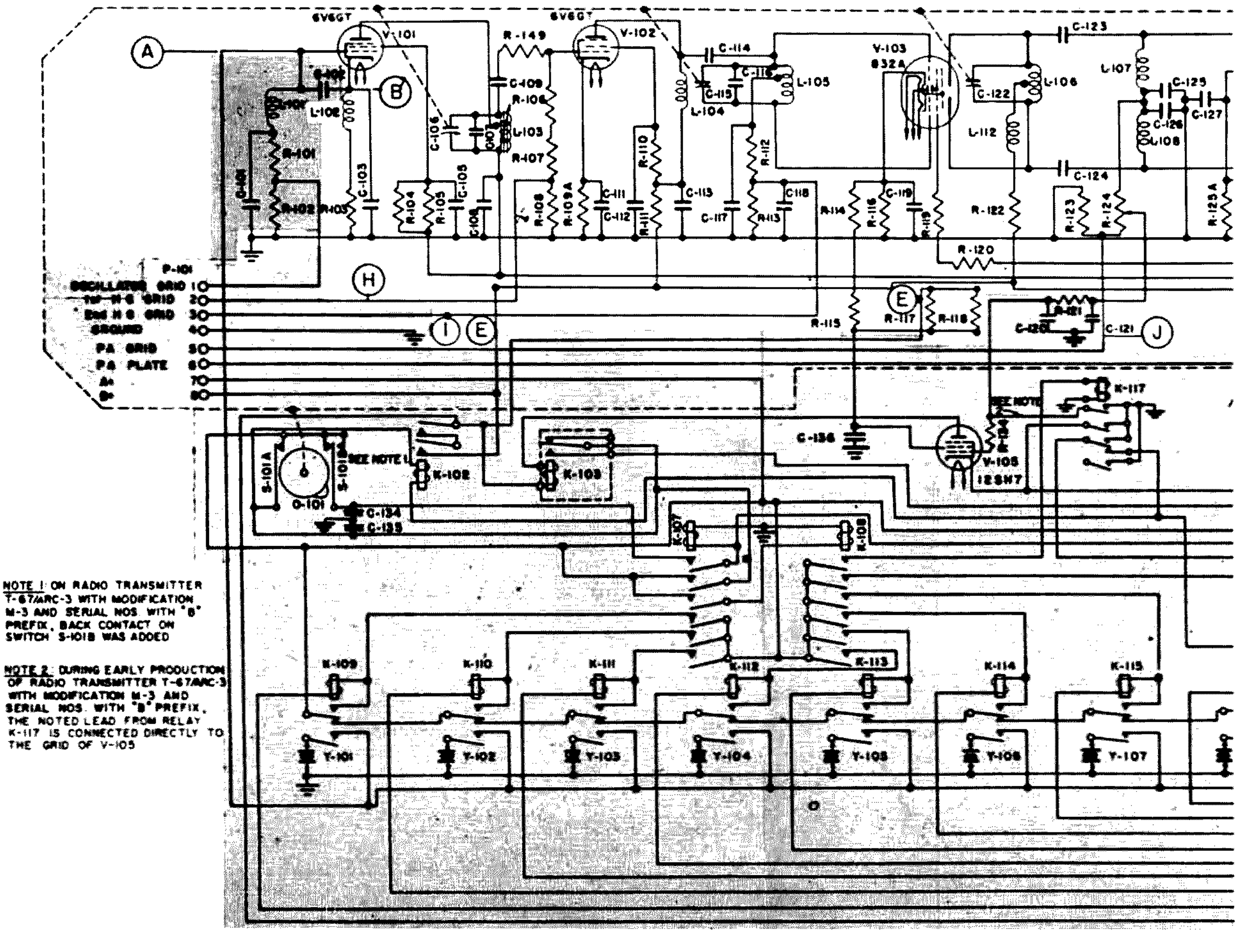


Fig. 4: Schematic diagram of the T-67/-ARC-3. Shaded areas indicate deleted wir-

The companion unit to the R-77/ARC-3 receiver[1] is the T-69/ARC-5 transmitter. This unit is an AM, VHF transmitter with an output of 8 watts on any one of 8 crystal controlled frequencies in the range of 100 to 156 mc. The transmitter is reasonably compact, measuring approximately 7½" x 12" x 15¼", and weighs some 21 pounds. This equipment was designed for aircraft service and used an external dynamotor to supply 400 volts dc at 325 ma. The usual 28 volt dc aircraft supply was used for the tube filament strings, relays and microphone.

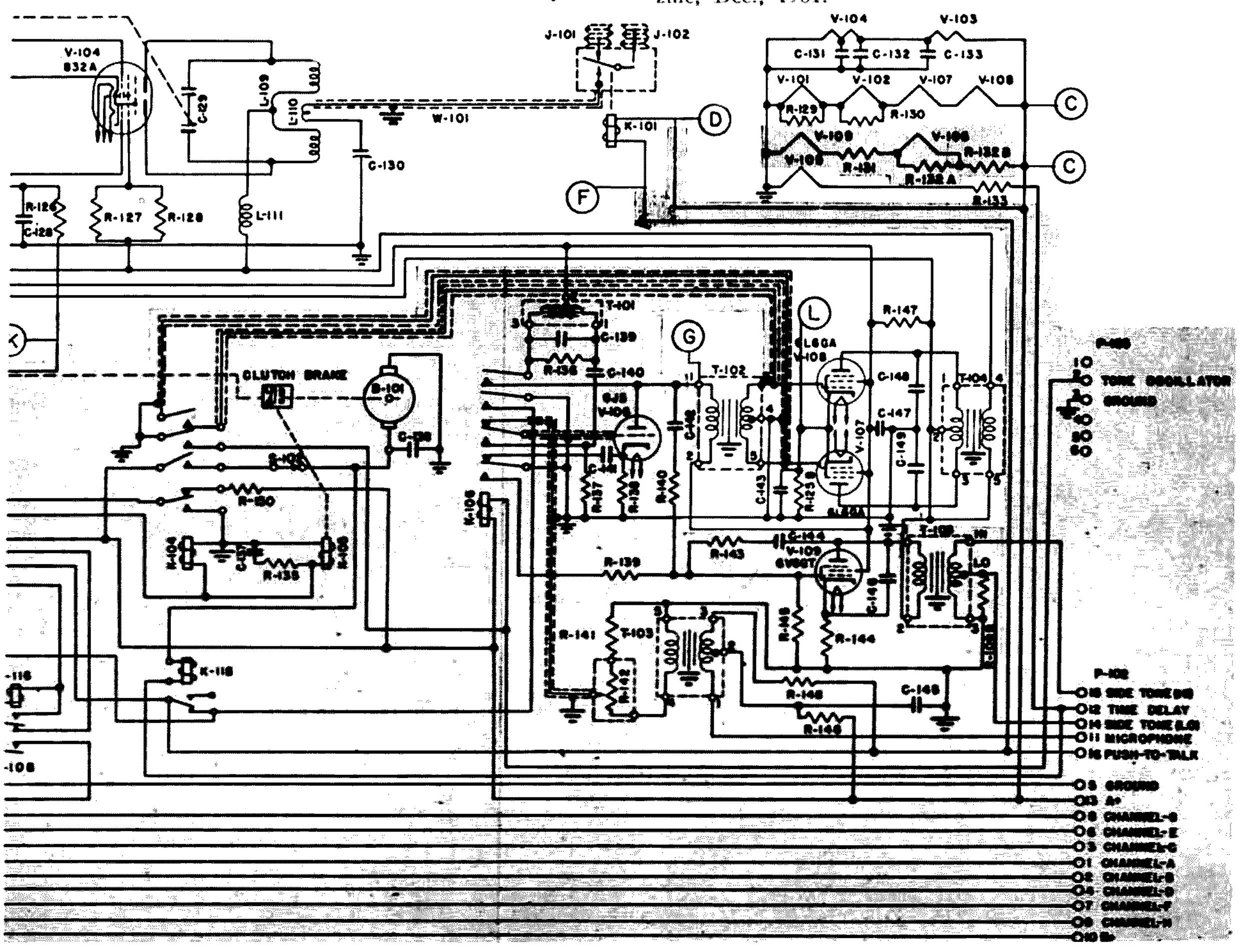
The transmitter easily converts to amateur service, however considerable work is required to end up with a commercial appearing unit. The major attraction of the T-67/ARC-3 is the current market price which ranges from $12.00 to $20.00, depending on source and condition. At this price, a substantial investment in time and effort in the conversion is justified.

The circuit uses 9 tubes, two of which are deleted in this conversion. Fig. 3 shows a block diagram of the transmitter. A 6V6 modified Pierce oscillator is used with the plate circuit tuned to the second harmonic of the crystal. A second 6V6 is used as a tripler, driving an 832 which triples to the air frequency. A second 832 is used as the power amplifier which is link coupled to the antenna through an internal, coaxial antenna change-over relay. The speech section uses a 6J5 driver for the push-pull 6L6 modulators. Sidetone amplifier (6V6) and automatic tuning control (12SH7) stages are provided but are removed during the conversion. The motor driven, automatic tuning system is deleted completely.

In common with much aircraft gear, most of the equipment complexity derives from the multi-channel, remote control requirement. The system used is almost identical to that of the R-77/ARC-3 receiver. The theory of operation was described in detail in the previous article and will not be repeated here. The only substantial change is that the tuned circuits will not resonate to any but the desired crystal harmonics so that the pre-set lock-out is not required.

In this conversion, the automatic tuning and crystal selection circuits are deleted and the required controls are brought through a new

1 Another Two Meter Conversion, W4WKM, 73 Magazine, Dec., 1961.



ing. Circled letters are keyed to additional wiring in Fig. 5.

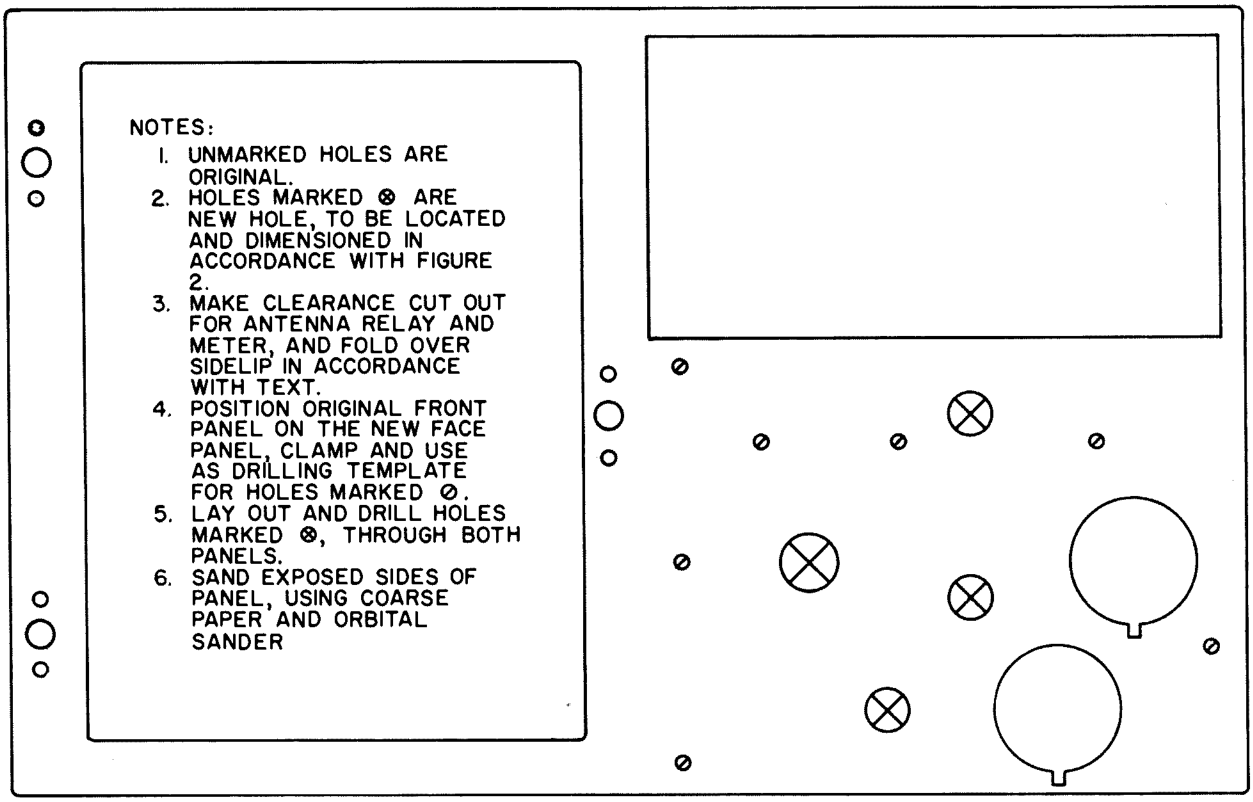


FIGURE 1

front panel. In this connection, it will be noted that the photographs and the panel drawings show an output coupling control. Aside from being a mechanical nightmare, experience has indicated that this control is not actually required and it may be deleted in the interests of simplicity. The crystal oscillator is converted to a VFO and a meter and meter switch are added. An ac operated power supply is added and is self contained except for the 115 volt isolation transformer. *WARNING!* The voltage tripler power supply used places the chassis at ac line potential. Do not operate without an isolation transformer as shown in Fig. 5.

While it is desirable to follow the concept of minimum required change in surplus conversions, the best approach is often difficult to determine. In this case, two choices existed. All control, audio and power circuit wiring could be removed and the transmitter rewired almost from scratch. On the other hand, since the transmitter wiring is neatly laced and the wiring harness is held in position with a generous number of cable clamps, it is possible to slit the lacing where necessary and still retain the neat wiring arrangement. After a careful study of the transmitter, the wiring diagram and the schematic, it was decided to use the original wiring scheme with deletions and additions as required. The first wire out of a run is the hardest; the rest are easy.

The unused wiring and parts are removed first; new parts and wiring are left until the trees can be distinguished from the forest. The

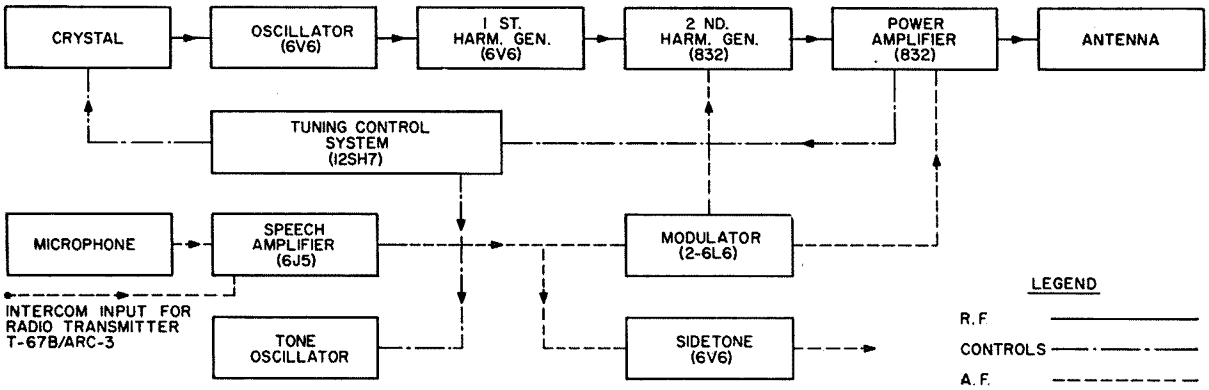


FIGURE 3

step-by-step instructions may seem complex and difficult, but work progresses rapidly and the procedure is self-checking.

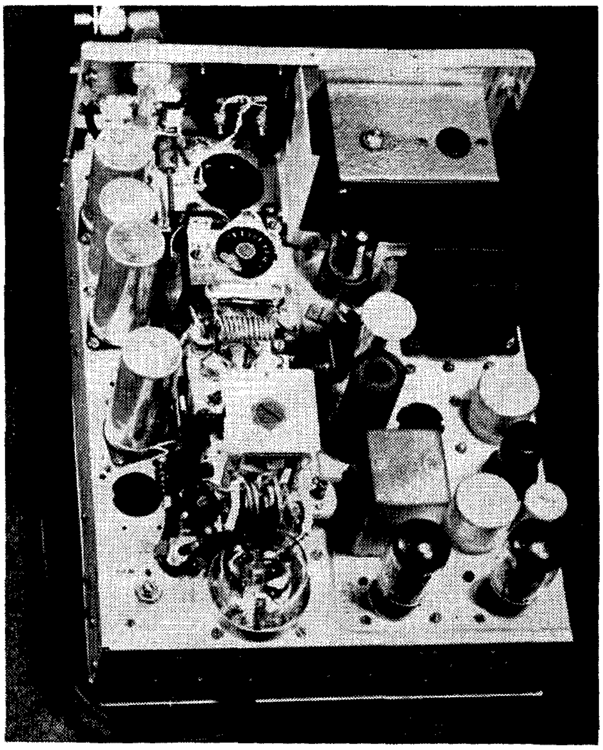
Remove the transmitter from the shockmount base and discard the base. Scribe the oversize bottom plate, along the sides of the case. Remove the bottom plate, shear to the scribe marks and discard the scraps. Remove and discard the snubber brackets secured to each corner of the chassis. The rear brackets are riveted in place and the rivets should be filed off. Fill the vacant holes with machine screws. Remove and retain the top cover of the case.

Remove and discard the crystal access door. File off the three rivets which secure the protective strip to the top lip of the front panel. Remove the nomenclature plate and discard along with the mounting screws. Remove and discard the 6L6 and 832 tube hold-down clamps. Remove and discard V-105, V-106, V-109 and K-103; replacing V-106 (6J5) with a 12J5 tube.

Remove the hardware mounting all components on the front panel and remove the panel. Drill and cut the panel as shown in Fig. 1. The projection on the panel on which the connectors are mounted should be peened over to present a smooth surface on which the new face panel may be mounted. Sand or steel wool the edges of the panel and the sides and back of the chassis. Using 16 gauge sheet aluminum, cut and drill a new face panel in accordance with Fig. 2. Make sure the holes in the two panels register. Finish the top cover and the new face panel in flat black lacquer and set these items aside for future use.

Unsolder from Pins 1 and 5 of V-101 the white-black and white-green leads which run from the back of the crystal box. Dismantle and discard the crystal box, leaving the crystal socket-relay assembly intact. Cut the lacing on the cable between this assembly and P-102. Cut out and discard the leads running between Pins 1, 2, 3, 4, 6, 7, 8 and 9 of P-102 and the relays. Slit the cable harness as required, unsolder the chassis end of the following wiring and discard the complete crystal socket-relay assembly:

FROM	COLOR CODE	TO
Coil, K-109	White-Brown-Red-Green	Contact, K-107
Coil, K-110	White-Brown-Red-Blue	Contact, K-107
Coil, K-111	White-Red	Contact, K-107
Coil, K-112	White-Black-Brown-Green	Contact, K-108
Coil, K-113	White-Black-Brown	Contact, K-108
Coil, K-114	White-Brown-Red	Contact, K-108
Coil, K-115	White-Brown-Green	Contact, K-108
Coil, K-116	White-Black-Brown Orange	Contact, K-108



Contact, K-109	White	Contact, K-107
Contact, K-116	White-Black-Green-Black	Coil, K-107

Locate the altitude gain control on the left front of the chassis, disassemble and discard all components except R-142. Clip the three leads attached to the tuning drive motor assembly. Discount and discard the complete assembly consisting of B-101, C-137, C-138, K-105 and R-135. Pull the three leads out of the wiring harness, unsolder the terminated ends and discard. These leads are routed as follows:

FROM	COLOR CODE	TO
C-138	White-Black-Brown	Contact, S-102
K-105 - R-135	White-Black-Brown-Red	Pin 4, K-103
B-101	White-Black	Chassis Ground

Position the new face panel over the front panel and secure in place with the 4 corner screws. The holes on the left side of the panel mount the VFO enclosure and dial. The dial shown in the photographs is a modified National type MCN and the box is a Bud type AU-1028. Any suitable dial and enclosure may be used and the panel drilling altered accordingly. The VFO tank circuit, shown in Fig. 5, should be mounted in this box. The components specified give a satisfactory tuning range.

In any event, construct in accordance with good VFO practice and juggle coil slug and trimmer capacitor to give the desired coverage of 8,000 to 8,222 kc. Achieve rough settings with a grid dip meter and accomplish final alignment after the equipment is working. Ex-

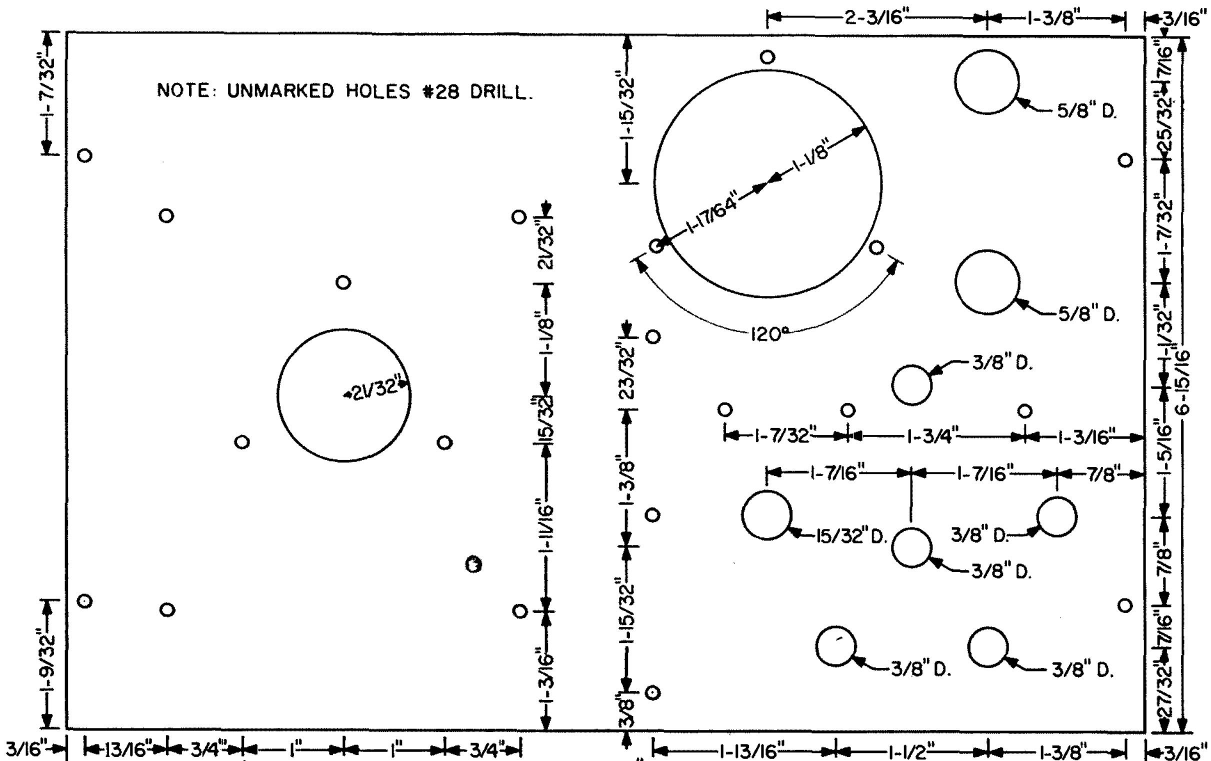


FIGURE 2

Drilling details of new face panel. Material: 16 gauge aluminum. Finish: prime and apply 2 coats flat black lacquer to front only.

tend the V-101 grid lead out the bottom of the box with a short length of #14 or #16 solid, insulated wire. Install the cover on the box and mount the new meter, meter switch, microphone jack, ac line switch and the original antenna relay, K-101, on the panel. Remove and discard the mounting bracket for C-145 and move the capacitor, with leads attached, out of the way for later disposal. Secure the front panel to the chassis, using original hardware.

The audio section of the transmitter contains sidetone amplifier and tone oscillator circuits that are not required in this conversion. The wiring associated with these circuits should be removed and discarded:

FROM	COLOR CODE	TO
Pin 5, V-107)		(Contact, K-104
)	Shielded Cable	(
Pin 5, V-108)		(Contact, K-104
Pin 4, T-103	White-Green	R-142
Pin 3, T-101	White-Black	Contact, K-106
R-137	White-Black	Pins 1 & 2, V-105
R-137	White-Black	Ground Lug
Junction C-140 - R-137	White-Brown-Green	Contact, K-106
Pin 2, T-101	White-Brown-Red	R-147
Pin 3, V-106	White-Brown Black	Contact, K-106
Pin 14, P-102	White-Black-Green	LO, T-105
Pin 15, P-102	White-Brown-Red-Green	HI, T-105
Pin 1, T-105	White-Red-Blue	Pin 3, V-109
Pin 2, T-105	White-Red	Pin 5, T-104
LO, T-105	White-Black Green	R-109B
Pin 3, V-109	White-Red-Green	Junction C-144 - C-146
Pin 5, V-109	White-Green	Junction R-139 - R-140 R-143 - R-145
Pin 4, V-109	White-Brown-Red	Pin 2, T-102
Pin 8, V-109	White-Brown	R-144
R-144	White-Brown-Red-Black	Pin 2, V-109
C-145	White-Black-Brown	R-146
C-145	White-Black	Chassis Ground
C-142	White-Brown-Blue	Pin 3, V-106
R-139	White-Black-Green	Contact, K-106
Pin 3, T-103	White-Black-	R-148
R-148	White-Black-Brown	Coil, K-102
C-141	White-Black-Red	Contact, K-106

Ground the unterminated lead of C-141 to a lug secured under its mounting screw. Unsolder the shielded lead, coded White-Green, from the center contact of R-142 and connect to Pin 4 of T-103. Secure the ground lug under a transformer mounting screw. Clean up R-142, discarding R-141, and mount on the front panel as the audio gain control. The White-Green lead runs in a shielded cable, along with the White-Brown-Green lead connected to Pin 5

of V-106, to the contacts of K-106. Unsolder these leads from K-106 and route to the audio gain control, connecting the White-Brown-Green lead to the rotor and the White-Green lead to the clockwise contact of this resistor. Pick up chassis ground from the sleeve contact of the microphone jack, connect to the ground end of R-142 and connect to the meter switch in accordance with Fig. 5.

Remove and discard transformers T-101 (with terminal board) and T-105; capacitors C-142, C-144, C-145 and C-146; and resistors R-139, R-140, R-143, R-144, R-145 and R-148. At this time, the terminal board adjacent to V-109 should be clear of parts except for R-117 and R-118. V-109 socket should be clean except for the heater connections on Pins 2 and 7.

Excess power and control circuitry and components should be removed to make room for the ac power supply and to simplify the finished product. Remove and discard the following wiring:

FROM	COLOR CODE	TO
Pin 12, P-102	White-Black-Brown	R-133
Pin 12, P-102	White	Coil, K-118
Coil, K-118	White	Contact, S-102
R-113	Bare Wire	Pin 7, V-105
Pin 5, K-103	White-Black-Brown	Pin 8, V-105
Coil, K-102	White-Brown-Brown	Contact, K-106

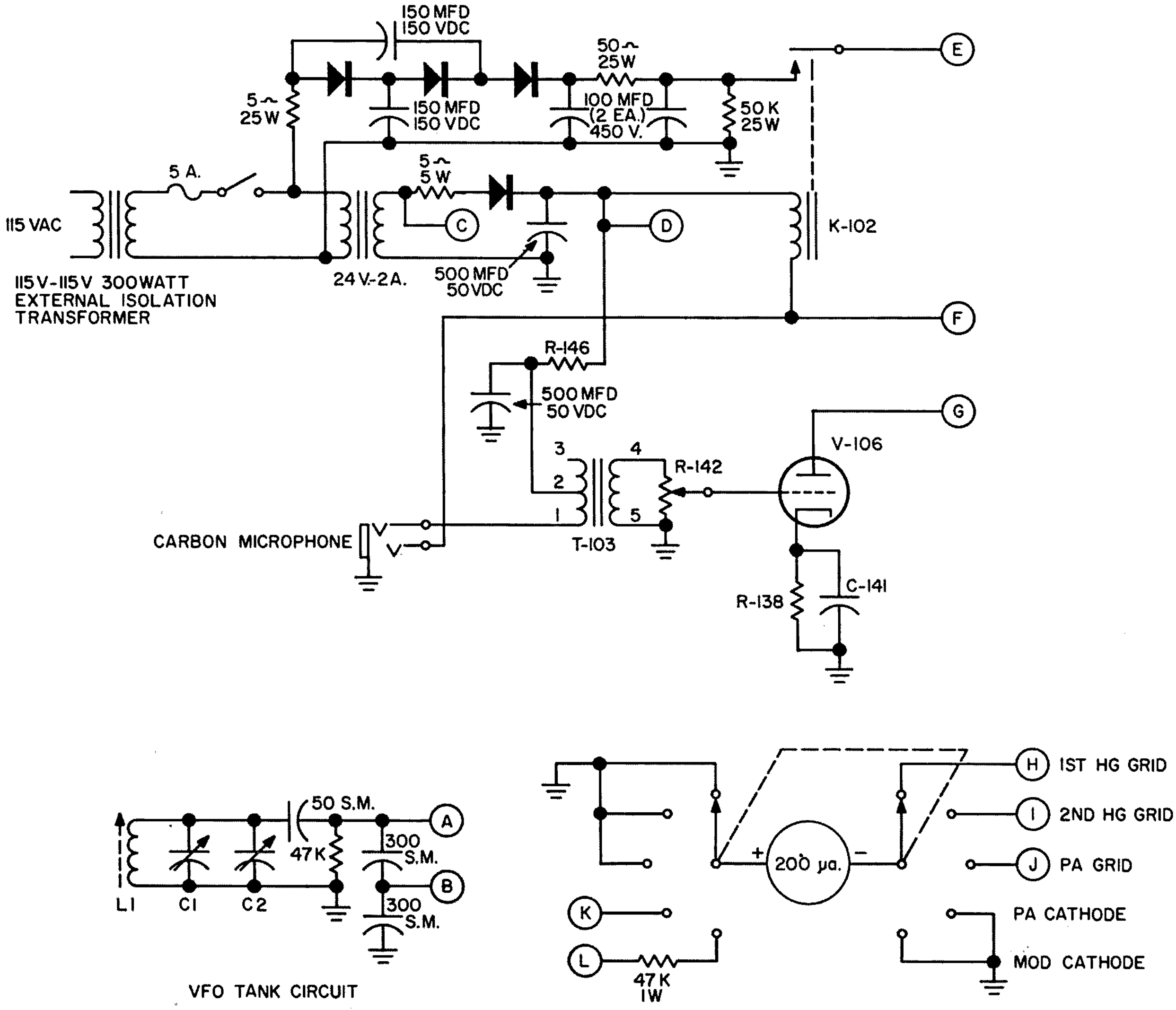


FIGURE 5

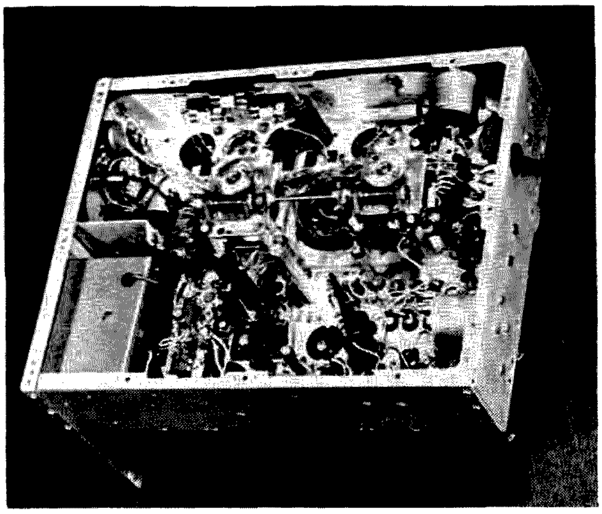
1. Circle letters keyed to Fig. 4.
2. 3 digit part numbers are original parts redrawn from Fig. 4 for ease of reading.
3. All diodes are Sarkes Tarzian M-500 or equal.
4. VFO tank circuit to be trimmed to cover 8,000 to 8,222 kc.
   Prototype used following values:
   C-1 . . type "APC" capacitor cut to 2 plates.
   C-2 . . 4.5-25 mmfd ceramic trimmer capacitor.
   L-1 . . 17 turns #26 PE wire on 3/8" surplus, slug tuned coil form.
5. Warning! Chassis is at line potential . . isolation transformer must be used.

Contact, K-106	White-Brown-Brown Spliced to White	Contact, K-117
Contact, K-117	White	Contact, K-118
Coil, K-102	White-Brown	Contact, S-101A - C-135
Coil, K-102	White-Brown	Pin 2, K-103
Pin 2, P-103	White-Black-Orange	Coil, K-106
Pin 3, P-103	White-Black	Chassis Ground
Coil, K-106	Black	Contact, K-104
Coil, K-104	White-Brown-Red-Black	Pin 4, K-103
Coil, K-106	White	R-150
R-150	Remove and Discard R-150	Contact, K-104
Coil, K-106	White	Contact, K-104
Coil, K-106	White	Contact, K-107
Coil, K-106	White	Pin 7, V-103
Pin 7, P-101	White	Contact, K-108
Contact, K-108	White-Black	Contact, K-107
Contact, S-101A	Bare Wire	Contact, S-101B
Contact, S-101A	White	Pin 13, P-102
Contact, K-117	White	Contact, K-118
Contact, K-118	White	Coil, K-101
Coil, K-101	White	Pin 16, P-102
Coil, K-108	Black	Contact, K-107
Pin 5, V-105	White-Black-Brown	Contact, K-104
Contact, K-104	White	Contact, K-117
Contact, K-117	White-Black	Pin 4, V-105
Contact, S-102	White-Black-Red-Black	Contact, K-104
Coil, K-117	White	Contact, K-108
Pin 5, P-102	White-Black	Chassis Ground
Pin 4, P-101	White-Black	Chassis Ground
Coil, K-108	White-Black	Chassis Ground
Coil, K-108	White-Black	Contact, K-106
Contact, K-106	White-Black	Contact, K-104
Coil, K-108	White-Black	Coil, K-107
Coil, K-107	White-Black	Coil - Contact, K-104
Pin 1, K-103	White-Red	Contact, K-102
Pin 8, P-101	White-Red	R-147
R-124	White-Green	Junction R-121 - C-121
S-101B	White-Black	Contact, K-107
R-131	White-Black	Pin 7, V-109
R-131	White-Black-Brown-Orange	Pin 2, V-106

Unsolder the two leads from Pin 6 of V-105; solder these leads together, insulate and lace them to the wiring harness. Install a 6 lug terminal strip on the underside of the chassis, close to the VFO box. Unsolder from S-101B the White lead that runs between this point and Pin 7 of V-103. Dress this lead to the front of the chassis and connect to one of the lugs. Unsolder the remaining White lead from Pin 13 of P-102 and connect it to the same point. The 24 volt AC transformer will connect between this lug and ground.

Unsolder from the contact of K-102 the White-Red lead which runs to the junction of R-117 and R-118. Solder this lead to the top of R-147. The second White-Red lead should be left on the K-102 contact and the other end removed from Pin 10 of P-102. Dress this lead under the chassis and terminate on a vacant of the above mentioned terminal strip for B+ connection.

At this point, both coil terminals of K-102 and one terminal of K-101 should be vacant.



The other coil terminal of K-101 has a White lead which terminates on the top of R-146. This lead remains. Unsolder the White lead from the top of R-132 which runs to the top of R-146 and connect to one coil terminal of K-102. Transfer the remaining White-Brown-Brown lead from Pin 16, P-102 to the vacant coil terminal of K-101. Attach a lead to this point and terminate it on the tip terminal of the microphone jack. The White-Brown-Brown lead is spliced in the vicinity of K-102 and continues to R-148. Open this splice and connect both leads to the vacant coil terminal of K-102. Clip the White-Orange-Green lead from Pin 11 of P-102 and connect to the ring contact of the microphone jack.

Clip the bare lead attached to the bottom of R-132 and use this wire to strap Pins 1 and 2 of V-106. Unsolder the lead from the center contact of R-132 and the leads from the top of R-132. Remove and discard R-132, substituting R-133. Connect the lead removed from the center contact of R-132 to the bottom of this resistor and the two top leads to the top of R-133. Referring to Fig. 5, install and wire the 24 volt DC components on the partially vacated terminal board adjacent to V-109. Interconnect with the original wiring as shown in Figs. 4 and 5. Connect the AC input to the top of R-133 (former R-132) and the DC output to the top of R-146.

Unsolder R-134 from Pin 4 of V-105; remove and discard R-134, R-121, C-120 and C-121. Remove and discard the following components, including mounting brackets if not used to mount other components, and reinstall hardware if required to secure other assemblies: Relays K-104, K-106, K-107, K-108, K-117 and K-118; Capacitors C-134 and C-135; Switches S-101A, S-101B, and S-102; Connectors P-102 and P-103; and the sockets for K-103, V-105 and V-109.

Unsolder the White-Green lead from the junction of L-101 and C-101 and pull through the wiring harness to where it terminates at R-101. Shorten this lead as required and terminate on Pin 8 of V-107. Remove and discard R-101 and R-102; replace R-101 with a 47,000 ohm, 1 watt resistor. Replace R-126 with a 27,000 ohm, 1 watt unit. These steps transfer the meter lead attached to Pin 1 of P-101 from the oscillator grid to the modulator cathodes and change the modulator and PA meter resistors to values compatible with the meter used. Transfer the remaining 5 leads from P-101 to the meter switch and wire the meter and switch in accordance with Figs. 4 and 5. It should be noted that the arbitrary scale used on the meter is not calibrated and that the meter resistors are merely selected to give convenient readings. Any deviations from normal are easy to spot with this system.

Unsolder and discard C-101, C-102, C-103 and L-101 from the V-101 oscillator grid circuit. Install the additional VFO grid components shown in Fig. 5 and connect the new grid tank lead as indicated.

The coupling on the end of the main tuning drive shaft is removed and the hub from a standard ¼" flexible coupling is sweat soldered to the projection of the shaft. A H. H. Smith #166 flexible shaft and panel bearing is installed and the shaft cut to the proper length for easy rotation. A combination of a home-made right angle drive, flexible shafting and brass rod was used for the antenna coupling Rube Goldberg. As previously mentioned, this feature is not essential; if you want to install it, you are on your own. Knobs, decals and right angle coaxial adaptors with type BNC reducers complete the front panel work and give a commercial appearance.

Mount the power supply components in the general areas shown in the photographs and wire in accordance with Figs. 4 and 5. The 24 volt transformer specified may be used or you, as the writer, may wind your own. Carefully check your wiring, visually and with an ohmeter. If all looks good, remove the input silicon rectifier and plug into the *external isolation transformer*. Apply power, plug in a T-17 or equal mike and check for lighted tubes and proper relay operation. If operation is normal, remove power, install the silicon rectifier, connect a 6 watt, 117 volt lamp as a dummy load and reapply power. Check for smoke and measure the B+ voltage which should be slightly below 400 volts under load.

Set the VFO to mid-range and tune the

ganged tuning control for maximum PA grid current. Touch up the slug in L-103 and the mechanical trimmers on C-106, C-115 and C-122 for maximum grid drive to the PA. Adjust C-130, the antenna coupling link and the mechanical trimmer on C-129 for maximum brilliance of the lamp load. Using a frequency meter or calibrator checked receiver, adjust the VFO coil slug and trimmer capacitor for a coverage of from 8,000 to 8,222 kc. Advance the audio gain control, while talking into the mike, until the lamp brilliance increases on voice peaks. Tune the signal in on a local receiver and check the quality of the signal, taking such corrective measures as are indicated. On the air operation is next on the agenda and if reports are good and the FCC isn't camping on your doorstep, you are ready to button it up. Dress up the wiring and replace the cable runs that are too chewed up. Install the bottom plate and top cover to complete the job.

In retrospect, several changes could be made in this conversion. Admittedly, use of a power tube such as the 6V6 would not be attempted in a "from scratch" VFO design. Further, lack of voltage regulation and the location of the tank circuit next to the heat producing power supply components will draw screams from the purists. Despite these handicaps, performance is good. Of course, there is drift but even a selective receiver has no difficulty in keeping up with the signal. For those who wish, the oscillator can be left as is and a front panel crystal socket installed. This will solve the problem and greatly simplify the conversion. Use of an existing, external power supply, if desired, will further decrease the effort required in this conversion.

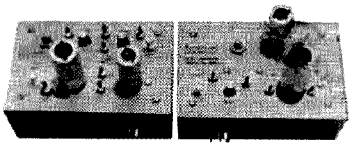
Despite the problems encountered and the effort expended, this is a satisfactory conversion. Good performance, low cost and commercial appearance more than compensate for the work involved. . . . W4WKM

Photography by: Morgan S. Gassman, Jr.

FCC ACTION

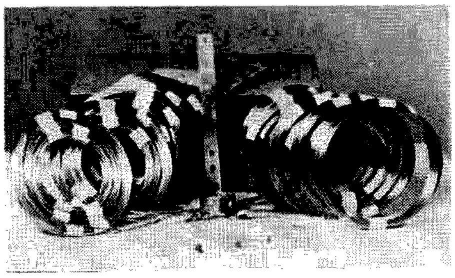
The FCC has amended our regulations to permit mobile operators to simplify their log keeping in that they no longer have to log time times of start and endings of each contact, but only have to log the time of starting operation and ending operation. Big deal.

New Products



VHF Converters

Amplidyne Labs has come out with a line of converters and preamplifiers that look first rate. The two meter conveter uses two Nuvistors as grounded grid rf amplifiers, a 6J6 crystal oscillator and a 6BQ7 mixer. This gives excellent freedom from overload or crossmodulation on strong signals. The price is only $34.25 plus $9.75 for a matching power supply. The six meter model (on the right) uses a Nuvistor GG rf amplifier, a 6C4 crystal oscillator and a 6BQ7 mixer. Price is $28.50 (P.S. $9.75). The *if* output of both converters is normally 14-18 mc, but this can be changed easily or will be sent tuned to the band of your choice for $1 extra. Write for more info: Amplidyne Labs, Box 673, Kings Park, L.I.N.Y.



Radial System

You can have a mighty frustrating time trying to get all that stuff up there in the air to radiate unless you have a fairly decent ground system underneath it for it to work against. Ready Radials has a kit of radials, a central hub and drive pegs available for $24.95 which will put a hard top on that rf sponge under your antennas. Send for info and watch your eyes bug out as you find out how important this unfortunately neglected key to antenna efficiency really is. Ready Radials, Box 5496, Winston-Salem, N. Car.

What is the Institute of Amateur Radio?

Basic Purpose: To enable amateurs to get more fun out of ham radio.

( ) Since it is axiomatic that the more you know about ham radio the more fun you will have, one of the main interests of the Institute is to encourage technical proficiency.

b) World friendship, through our hobby, leads to greater enjoyment and international good will. In the interests of this the IoAR will be sponsoring a number of international "tours" to enable U. S. amateurs to personally meet foreign amateurs. Group travel permits Institute members and their families to travel at a considerable saving over the normal trip costs.

c) Since the present FCC system for modifying rules and regulations favors the majority views it is important that minorities be able to present their ideas and be given every encouragement for technical advancement. The IoAR will try to help such minority groups to be better understood and to promote legislation which will help these groups where it is not to the detriment of the majority. Ham groups interested in TV, RTTY, wideband FM, remote repeaters, remote control, etc., are cases in point.

d) Our hobby will be the most fun for the most operators when our rules and regulations meet the immediate present day demands of active amateurs. By encouraging discussion and progressive thinking along these lines the IoAR hopes that amateurs will take a greater interest in the running of their hobby and will exert their influence intelligently.

e) It is NOT the intention of the Institute to become a second ARRL. This means that unless the members of the IoAR decide otherwise there will be no QSL Bureaus, no traffic handling nets, no myriad of contests, etc.

MEMBERSHIP: Open to anyone interested. Dues are $1 per year.

Please give name, call, class license, year first licensed, address, city, zone, and state on your application. Send application to:

Institute of Amateur Radio
Peterborough, New Hampshire

Verviers Rally

A Funny Thing Happened To Me On The Way To The Zwaanaardestraat . . . .

Dear Wayne,

Amateur radio history was made on Sunday, April 28th in a small town in Southern Belgium. The Verviers Rally marked the dawn of a new era in amateur radio . . . the beginning of Reciprocity!

Though much has been written and a lot more pronounced on the subject of reciprocity, it was the Belgians and the Dutch, always reputed for their good sound sense, that broke the ice and arranged it so that overseas amateurs could obtain temporary licenses for a short period to cover the Verviers Rally.

The result was a shower of overseas amateurs, their wives and families, in gay vacation spirit, descending on the area in off-season . . . no doubt to the gratification of hotel keepers and the souvenir stores.

British, French, German and U. S. amateurs applied for the distinctive ON5 and PA9 calls. They were only on for the one weekend, too bad if you missed them!

I crossed the English Channel with my husband G3NMR, our two sons and guests G3BHT and G3PAH, all in our large station wagon which was complete with a little SSB transceiver, the fabulous Little Courier, as described in the journal of the Amateur Radio Mobile Society, plus a two meter rig. Though we were armed with enough documents to bog down the car at no time was any of the mobile gear questioned by customs officials and the sheaf of papers returned to London virgo intacta.

Naturally it poured the whole day of the Verviers Rally. Even so there were many contests, including a fox hunt, a treasure hunt, etc. No doubt you'll find the scores recorded somewhere in some radio magazine for those interested in such mundane matters, but the important thing was that everyone had a marvelous time and that good humor, friendship, cooperation and good will were the rules of the day. The noise of many nationalities all talking different languages at the prize-giving was thrilling to hear.

One of the real high points for any trip is the different food that you encounter. I'll never forget a Dutch breakfast: six different kinds of bread, slices of butter, loads of ham, Dutch cheese, jam, chipped chocolate to sprinkle over your thickly buttered currant bread and the finest coffee I've ever had. The breakfast, complete with hotel room with hot and cold running chambermaids cost only $2.50 per person!

On the Ostende-Brussels autoroute we operated as ON5ZC and worked, while in motion, a UA1, WA2, and a 5A4. CN8FR called us and held on until we crossed the Dutch border and changed to PA9NMR. The little Courier SSB transceiver sure gave a good performance.

In Rotterdam we worked a gaggle of two meter stations and in Leiden PAφHVN sent out mobile two meter stations to bring us in for tea. Other PAφ's soon rolled up and we had quite a hamfest right there on the edge of a daffodil field (the tulip bulbs are late this year due to cold weather).

The trip to Verviers was marvelous and all who attended had a wonderful time. Let's hope that the event will be yearly and that many times as many stations turn up for in next year.

Sylvia Margolis
(Mrs. G3NMR).

(W2NSD from page 7)

troversy I see no point in arguing about something that obviously was never intended to be anything but something to argue about. There are enough serious real problems afoot; let us hope that the ARRL directors don't get involved in this.

VHF Hamfest

The Microwave Society of Long Beach is sponsoring a three day hamfest June 14-15-16 at the Lafayette Hotel. Write to K6GKX, Box 3303, Long Beach 3, Cal. for info.

Swampscott

The Swampscott Convention this year seems to have been the biggest one yet. I know that our booth was jammed just about solid for the entire duration and we sold a record number of subscriptions to the magazine. Even more important to me was the flood of fellows taking time out to stand patiently around until they could break through the mob and tell me that they liked the magazine. This is quite a change over the reception of just two years ago when hundreds of fellows were amazed to find a new magazine in publication. This time not one chap wanted to know what on earth 73 was . . . they all knew.

It does not dismay me to report that our special issues of 73 have been driving one or two other ham magazine publishers to distraction. The big March Receiver issue really rocked them back on their heels. Nothing like this had even been thought of before. Then came the Transceiver section in the 128 page April issue! If you were one of the hundreds of readers that wrote in and thanked me for that one I want you to know that your letter, though unanswered, was appreciated.

In May we rested up with a smaller issue, gathering steam for this Surplus Special. As you thumb through the magazine you'll note that I have managed to round up the largest collection of surplus listings ever published anywhere. Only one or two surplus dealers managed to evade my persistance, plus a few that were deliberately left out so you won't have the misery that I have had in dealing with them. We've got the good guys here, with but few exceptions.

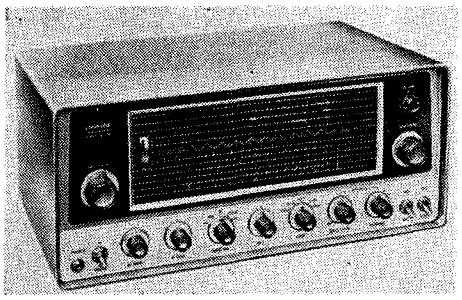
You might just as well read through the surplus section, for it is just as much a special section as that receiver compendium back in March. It cut down on the number of articles for this month, but that seems like a small enough sacrifice to get in this giant catalog.

Our fellow publishers can take heart that

we have nothing really outstanding planned for July and August, outside of a section on Quads and another on Towers. Heh, heh . . . wait'll you see that 40 meter quad! Watch out in September though . . . and OCTOBER! Our 4th annual October issue is going to be a corker. I won't tell any more about it right now for I don't want to ruin their summer completely. Oh, yes, I expect the subscription rates will be a little higher by then too . . . have to with the larger magazine, you know.

No Music to his Ears

The FCC, after a ridiculously long time, finally quashed the petition sent in by Fred Huntley W6RNC asking that amateur stations be permitted to play the National Anthem twice a day. RNC had been in trouble with the FCC over the rabble rousing "Anti-Communist Amateur Radio Network" broadcasts that he had been making. His mimeo machine seems to be still busy grinding out hate propaganda for weak minded hams to wallow in. I'm not sure whether he is still providing recorded telephone messages since he was publicly accused of anti-Semitism for one of his phone messages. The Anti-Defamation League said the "patriotic" materials RNC urged upon those who dialed his number included "staple horror items in the arsenal of professional bigots." Thank heavens out of the 250,000 hams we have in this country there are only a handful like this one. Now, how do we wash that hand?



New Product

Lafayette HE-80 Receiver

You'll want to know more about this new communications receiver announced by Lafayette Radio, 111 Jericho Tpk, Syosset, L. I., N. Y. The HE-80 sells for $149.50 and covers general coverage from 550 kc to 30 mc with electrical bandspread and separate calibrations from 10 thru 80 meters. It also covers 48-54 mc with dual conversion. It features a product detector, BFO, Q-Multiplier, crystal calibrator, ANL, S-Meter, and many other interesting points. Quite a package. Write Lafayette for more info.

Hamfest Tour of Europe

London Paris Geneva Rome Berlin!

Three weeks in Europe for only $550! This includes travel by air to all cities, hotels and breakfasts . . . plus our secret guide to low cost entertainment and restaurants in all cities.

SCHEDULE

Leave Idlewild N. Y. Oct. 6th
Arrive London AM Oct. 7th
Arrive Paris AM Oct. 11th
Arrive Geneva AM Oct. 16th
Arrive Rome AM Oct. 19th
Arrive Berlin AM Oct. 23rd
Leave Berlin Oct. 27th
Arrive Idlewild Oct. 27th

This being an all-ham flight will make it a lot more fun than an ordinary trip. In London, in addition to a big hamfest with the local ops, you will have four days to get lost in the underground, shop in the famous English shops, see a music hall and visit as many G's as you can manage. Then on to Paris where we will meet the French hams, shop in the Flea Market for unbelievable bargains, see the International Automobile Show, meet many INTERESTING French girls, see the Follies, the amazing Lido nightclub (costs $8, but wow is it worth it!), the Metro, the Eifel Tower, the Louvre and some coffee while watching the beautiful gals walking along the Champs. Next stop Geneva where you find the finest international shopping in the world, a visit to 4U1ITU, and maybe a side trip to Chamonix for the adventurous to ride the cable car up Mt. Blanc, one of the most exciting rides you'll probably ever run into. Rome is the next stop. We only have four days to do a months sightseeing and sample the ambrosia of their inexpensive but incredible restaurants. On Sunday we all can get a Papal Blessing . . . and wait'll you try the real Italian ice cream! Then we're off to Berlin, over 100 miles behind the Iron Curtain, where you'll not only see and feel the infamous wall, but you'll get a guided tour behind the wall and see for yourself the desolation of the Communist East Germany and East Berlin. Don't forget a camera and plenty of film. Berlin also has some of the finest shopping in Europe, one of the most famous zoos in the world, and some unforgettable nightclubs such as the Resi.

Since this is a club group it is necessary that one member of your immediate family must be a member of the Institute of Amateur Radio (send $1 to join). Send $250 with your reservation for each person going, the remaining $300 is due 60 days before blast-off, August 6th. Full refunds can be made up until one week before flight time should some disaster strike. We have to have the reservation money so we can reserve space on planes, in hotels, etc. Send reservations and check to the Institute of Amateur Radio, Peterborough, New Hampshire.

Compare the cost of this trip with the most economical regular air travel and you'll find that the same itinerary would cost you $630 for air fare alone. That's the nice thing about group travel and having a non-profit club running things.

We're going to all have the time of our lives, how about coming along. Even if you have to sell the car or borrow the money this will be well worth it . . . an experience you'll never forget.

73—Wayne Green W2NSD/1

(TV from page 64)

VIDEO & SYNC jack. You should now have a picture on your receiver or monitor. If the video from your scanner or camera has negative going sync and blanking, the switch on the modulator next to the 7F8 should be in the minus position, if the sync and blanking are positive going, the switch should be in the plus position. This should make the picture on your receiver positive. If your receiver is positive and your monitor has a negative picture and the switch is right, then remove the four screws on the MONITOR and ANTENNA plugs and lift out the diode probe box from the bottom. Reverse the polarity of the diode and replace the box. Trace the lead to the meter switch and reverse it also so that your antenna meter will read properly. Now both your receiver and monitor should have positive pictures.

You will find that slight retuning of the cathode line is required for the best picture.

Now remove the loop and connect the antenna and you are on the air!

Your average input with an 800 volt supply will be about 35 watts. Which means your peak input (on sync peaks) will be about 100 watts.

Raising the high voltage supply to about 1200 vdc will raise the average input to just under the 50 watt limit presently on the 420 mc band.

Without expensive test equipment it is difficult to obtain accurate power output measurements. Good dummy loads at 450 mc are not easy to come by. However, with 24 watts input there was sufficient output to cause severe overheating of a homebrew 4 watt dummy load made of 4 one watt carbon resistor. This type of resistor is a poor UHF load and would tend to cause power measurements to appear lower than they actually are. I believe that this transmitter is capable of eight to ten watts average output at 25 watts average input. In any case, this unit will make a substantial difference in signal strength over 1 and 2 watt type rig as well as providing a beautiful driver for a 500 or 1000 watt amplifier should the current 1 KW on 420 proposal be passed.

Some difficulty was encountered in acquiring 3C22's inexpensively, but we finally found that J. J. Candee Co., 509 N. Victory Blvd., Burbank, Calif. will supply them brand new and guaranteed for $15.00. The ART-26's less tubes, meter and power supply are available for $24.95 through Kencol Electronics, 2816 E. Norwich, Fresno 26, California. Don't mistake the APT-5 for the ART-26. This transmitter is similar in appearance but it is not a television transmitter. The 6AB7 and the 7F8 may be purchased locally but if you can't find any they are available through Allied Radio, 100 N. Western Avenue, Chicago 80, Illinois.

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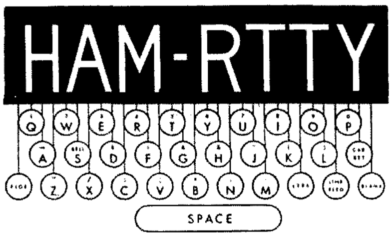
73 Products

Peterborough, N. H.

CARE AND FEEDING OF HAM CLUBS $1.00

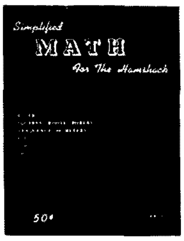
K9AMD's interesting book on all aspects of forming and holding together a ham club. This is the result of exhaustive interviews with many club officers and will be invaluable to every club going.

NEW RTTY BOOK $2.00



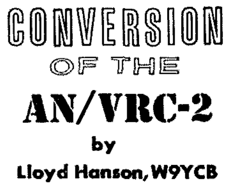
This handbook is written for the beginning RTTY op, but due to the profusion of info, pictures, circuits, etc., it will be valuable to all RTTY'ers and those who may RTTY themselves. If you don't know what RTTY means don't buy it. For $2 what can you lose? It's worth almost that much in paper.

SIMPLIFIED MATH 50c



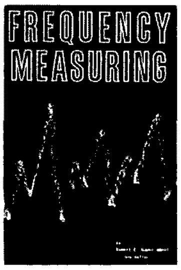
This booklet takes you gently by the hand and leads you through the mysteries of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc., and does it by an amazingly new method.

AN/VRC-2 CONVERSION $1.00



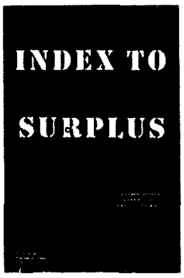
Exhaustively complete instructions on converting the surplus and inexpensive VRC equipment for six meter wide band FM ham net operation. Get thyself on 52.525 mc and join the national wide band FM activities.

FREQUENCY MEASURING HANDBOOK $1.00



Rather thorough exploration of the subject, complete with an exhaustive bibliography. By WφHKF

INDEX TO SURPLUS $1.50

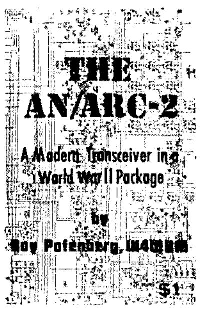


This is a complete list of every surplus conversion article that has ever been published, with a brief description of the conversion. Invaluable bibliography.

BINDERS FOR 73 $3.00

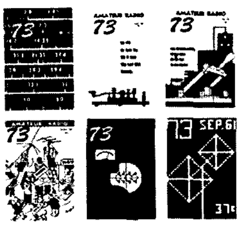
Keep your issues of 73 all in good shape and keep them from straying. Specify year: '60-61, '62, '63. Red Leather binder with gold stamped "73" and year. Darbs.

AN/ARC-2 CONVERSION $1.00



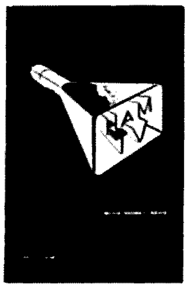
Complete schematics and thorough conversion details on this modern transceiver which covers 2-9 mc (80-40 meters . . . and 160). This unit now sells for $40 to $50 surplus and is easily converted into a terrific little transceiver.

BACK ISSUES 50c



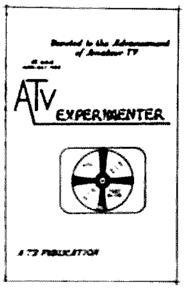
You can enjoy back issues of 73 just as much as current. Send for one each month to pad out those dreary days. All back issues now available except January 1961. Early issues going to $1 soon. Supply very limited.

HAM-TV $3.00



This book gives you a blow by blow description of how to get on the air on TV for under $50. This book is the reason that hundreds of hams are now going on TV. This is not the usual theory book, just a how-to-do-it manual.

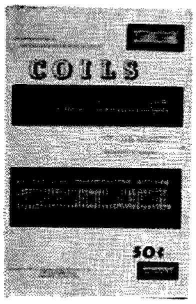
AMATEUR TELEVISION EXPERIMENTER $1.00 per year



The first six issues of this invaluable bulletin are now in print. Each one is worth more than the year's subscription. Send $2 for complete set from #1 up through #12. Quantity limited so don't wait.

SURPLUS TV SCHEMATICS $1.00

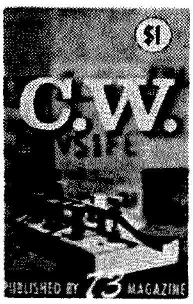
TV'ers who are interested in saving a lot of construction time and still want to have elaborate TV gear will do well to watch those surplus ads and invest in this booklet, the only source of the diagrams you'll be needing.



COILS 50c

Well illustrated basic book which describes all of the different types of coils to be found in radio work. Covers theory and practical aspects.

CW $1.00



Written by an expert. One of the best methods for learning the code yet devised. Lays in a good foundation for later high speed CW ability. CW can be a lot of fun if you go about learning it the right way. This book will be invaluable to the beginner and the ham who wants to really increase his code speed.

CALL BADGES

101—ENGRAVED NAME BADGES. Your first name and call engraved on 3" x ¾" laminated plastic, choice of red badge with white letters or black badge with white letters. Badge has safety lock pin so it can't fall off. These are great for club meetings, hamfests, etc. **$1.00**

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

3 NUVISTOR 2M PREAMP. Mar 63 p8
W9DUT Kit $18.50

1 TUBE ½W QRP 40M XMTR. Mar 63 p22
W1MEL Kit $6.00

2 TUBE 40M RCVR. Mar 63 p14
K6LJY-2 Kit $16.50

2 TUBE 40M XMTR. Mar 63 p14
K6LJY-1 Kit $24.50

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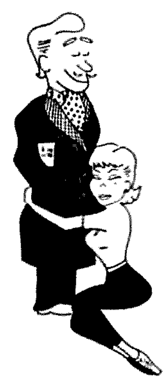

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73

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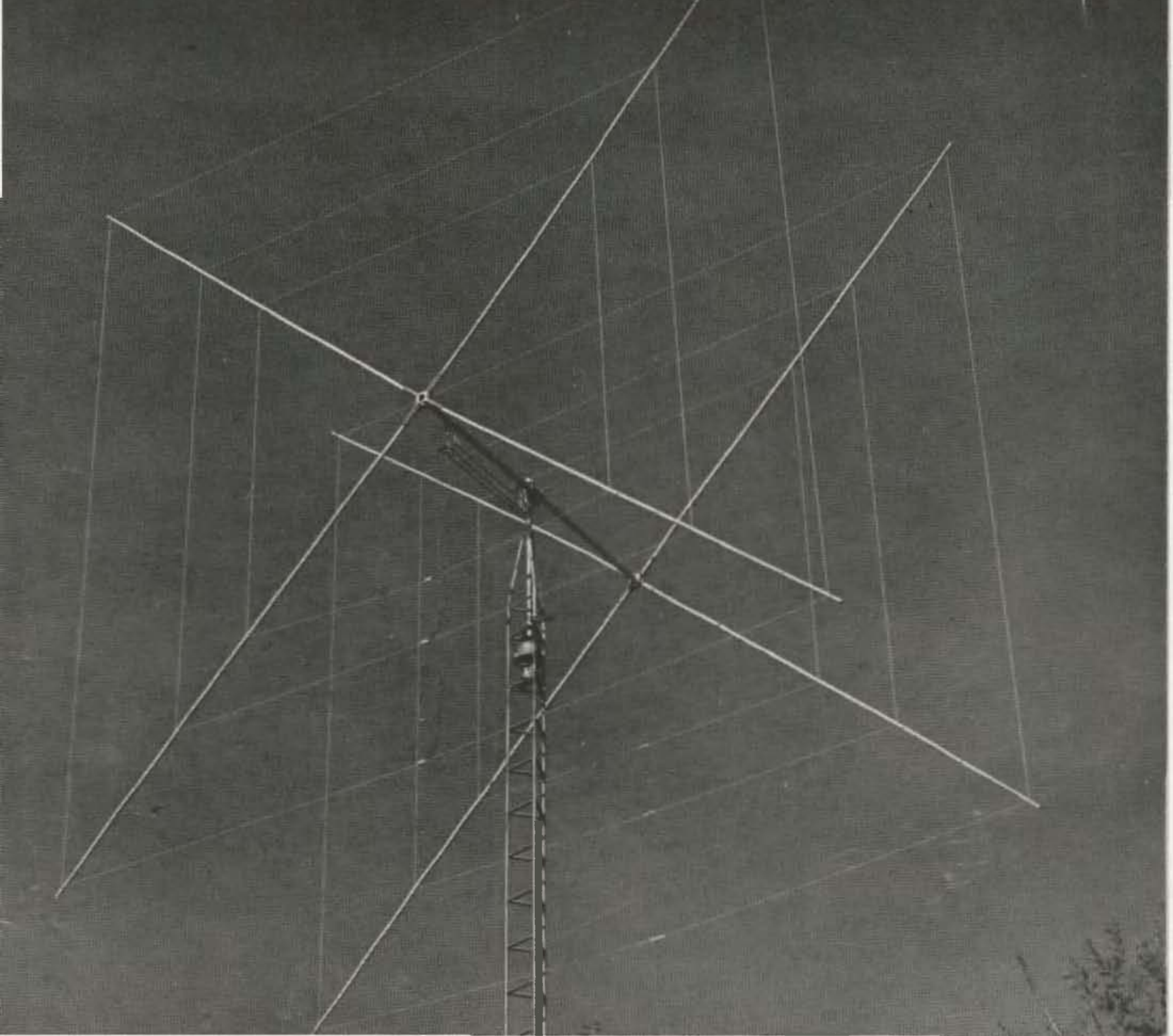
The same 40c

Amateur Radio

QUADS



73

Magazine

Weighn Green, W2NSD/1

Editor, etcetera

July, 1963

Vol. XIV, No. 7

Cover:

Cubex Mark III

73 Magazine is published monthly by 73, Inc., Peterborough, N. H. The phone number is 603-924-3873. Subscription rates are still abysmally low at $3.50 for one year, $6.50 for two years, and $9.00 for three years in North America and U.S. possessions. Foreign subscriptions are $4.00 per year. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in the U.S.A. Postmaster: please send form 3579 to 73 Magazine, Peterborough, New Hampshire. We told you last month to stop reading the fine print and stick to the articles and editorial.

de W2NSD

Never say die

Incentive Licensing

The editorials in QST and CQ on incentive licensing disturb me. From the mail that I have been getting on the subject it is obvious to me that many more amateurs are disturbed over this. And I might point out that many of the fellows who are upset over this write quite rational and intelligent letters. Many don't. If you are emotionally involved with this problem I suggest that you skip on to my next subject and pass over what I have to say here for once you are emotionally involved you will either agree with me without thinking or disagree with me without thinking and neither is of any value to either of us.

As I understand the background on this, there has been considerable pressure within the ARRL for QST to have something a little more controversial than their usually bland editorials. Possibly my frequently blunt editorials in 73 had something to do with this. The boss-man decided to kick off with incentive licensing as the first controversial subject and this was published in the February issue of QST.

The editorial *was* controversial, no question about it. I am pretty sure that the League has never before experienced an explosion such as they set off with that one. The editorial concluded that it was inescapable that "most amateurs want a return to the incentive system of licensing," and that "the U.S. licensing system has bred mediocrity and resulted in deterioration of the general level of our technical knowledge." They indicate that incentive licensing "would improve the quality of our signals and thus conditions in our amateur bands."

This raises several questions in my mind. First of all, is the ARRL, as it vehemently insists, speaking for its membership? Secondly, has there indeed been a breeding of mediocrity and a deterioration of technical knowledge? Thirdly, are the signals on our bands poor in quality, as they suggest? Would increased technical knowledge in fact improve these poor signals? Is this whole thing just for publicity? Are there other unstated reasons for this move?

I do not believe that the ARRL membership approves of this move. They admitted in the editorial that the extent of the sample taken before the editorial was limited to comments in their correspondence, at club meetings, conventions and on-the-air discussions. It is appalling that the ARRL should make such a sweeping move for change with such faint indications to go on. It is strange to me that my correspondence, which is not an awful lot less than theirs, has never discussed or suggested such a plan. Neither have I run into this scheme at club meetings, conventions or on-the-air discussions. Can it be that our worlds are so astoundingly different? Or are they guilty of exaggeration? If the ARRL has the courage to poll their members and make public this poll then we may find out what the members really think . . . and see if the ARRL obeys their mandate. I don't think they dare.

Now, about that mediocrity. It is fascinating to read 1935 issues of QST and find the same complaints being expressed then as today. Ham radio has carried along an assortment of lids and I doubt if the percentage is any greater today that it ever was. I have been in pretty close touch with our hobby for the twelve years that I have been writing and editing and I do not see this mediocrity. To the contrary, I have constantly been delighted to find so many technically equipped amateurs in our circles. If QST were to stop printing such an overwhelming mass of operating news and devote more space to technical and construction articles they might be in better touch with the amateurs who are interested in this phase of our hobby and appreciate more the vast engineering pool that we have. 73 has pioneered with a technical series written for the average ham instead of for the engineer (this series will shortly be available in book form)

(Turn to page 6)

(W2NSD from page 2)

and the response was immediate and positive. Amateurs are anxious to learn and they will read and learn if they are presented material by good writers and not engineering hacks that do not know how to explain complicated things in a simple way. Notice how seldom you find vectors and calculus in 73 . . . they just aren't really necessary and their use usually prevents the understanding that the author is attempting to achieve. The field of electronics has expanded in many directions and few old timers are able to keep up with paramps, transistors, sideband, television, RTTY, etc., on the technical level that they handled triodes back in 1932. I have been constantly amazed at the technical level of many of our newer hams. In talks at high schools I have been just about floored time after time by erudite technical questions from students. I have a great respect for them . . . and for hams in general.

Are the signals on our bands really poor in quality? Is this poor quality due to poor technical ability on the part of the ops or is it perhaps more attributable to deficiencies in the design of inexpensive commercial equipment. Would the perfection of these signals result in appreciably reduced congestion on the bands? If you do much operating you know the answers to these questions as well as I do. Sure, there are some chirps, drift and even a few rough notes. A few phone signals splatter and FM a bit. But the overwhelming number of signals on our bands are consistently good. If you eliminate the Novice bands you will have to tune quite a bit to find any really poor signals.

I am not at all sure that there is much correlation between technical ability and signal quality. Many fellows have transmitters with little flaws which cause difficulties which they could eliminate if they wanted to take the time and seriously hurt the resale value of their transmitter. Considering the profusion of articles we have published on improving commercial rigs, it is inertia and resale value that are more responsible for what few poor signals we have to endure more than technical ineptitude.

It does seem to me that any realistic examination of the problem shows us that this is largely a smoke screen. Technical training would have a slight effect on signal quality and we might find our bands slightly less congested . . . but at what a cost! Does the miniscule end justify the extraordinary means?

(Turn to page 74)

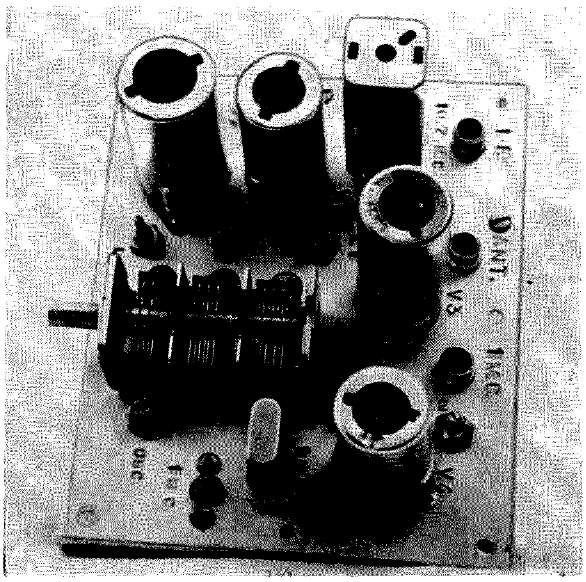
Sizzling Six

John Wonsowicz W9DUT
4227 N. Oriole Ave.
Norridge, Illinois

Parts kit available

Photos by Howie Trieb K9EPB

As the name implies, the tunable front-end herein described is HOT! In fact it is super sensitive and has to be tamed down with the aid of an rf gain control when tuning across the local signals or high power carriers. Six meter boys will be happy to use it as the front end of a receiver and the boys in the two meter or higher frequency range can use this module as the tunable if with their crystal controlled converters. This unit was designed as part of a new VHF receiver, but can be used with any superhet that tunes to 10.7 mc. An extra feature that can be incorporated, if desired, is the TMCS (Tone Modulated Crystal Standard) shown in the lower section of the photo. The construction of this unit appeared in Oct. 62 issue of 73. This small addition is worth the effort when it comes to calibrating the dial in one megacycle segments and later can be used to spot check the points and make corrections during tube changes.



Top view of the chassis showing the location of components: Tube in the upper left is the 6U8 oscillator and mixer, next to it is the 6EW6 rf amplifier and to its right is the J. W. Miller No. 1463 if transformer. The tube in the center of the chassis is the OB2 voltage regulator.

Circuit

The module uses only two tubes in the circuit. A 6U8 as the oscillator and mixer, and a 6EW6 as the rf amplifier. The 6EW6 with its low plate and screen voltage and its high gm (14000 micro mhos) falls in as a natural in high frequency application. Of course normal precautions should be observed in isolation between the input and output circuits of this tube, otherwise it will take off and no amount of by-passing will cure it; however, if the schematic is followed and the layout is close to the pictorial view, no trouble will be encountered with oscillations and you will come up with an excellent unit.

The original module when completed and optimized exhibited unusual sensitivity and a very good noise figure. Although the noise factor was not measured, it appears to be exceptionally low to be able to detect signals as low as .1 micro-volt throughout the entire tuning range of the module. Gain measured, using a Model 80 signal generator with accurately calibrated attenuator and a VTVM with an rf probe indicated to be 27 db. This is not outstanding and it wasn't meant to be, because emphasis was placed on sensitivity and low noise rather than gain. Gain can always be increased, by the addition of another stage in the if strip that follows, with no difficulty.

As noted on the schematic, link coupling is used in all critical portions of the circuit to prevent any feed through of stray signals.

These links were wound on the cold end of the coils and later connected by twisted leads to the link terminals on the coils forms. The system of making inductors with links, using J. W. Miller coil forms No. 41A000CB1 was described in the Nuvistor pre-amplifier in the past issue of 73.

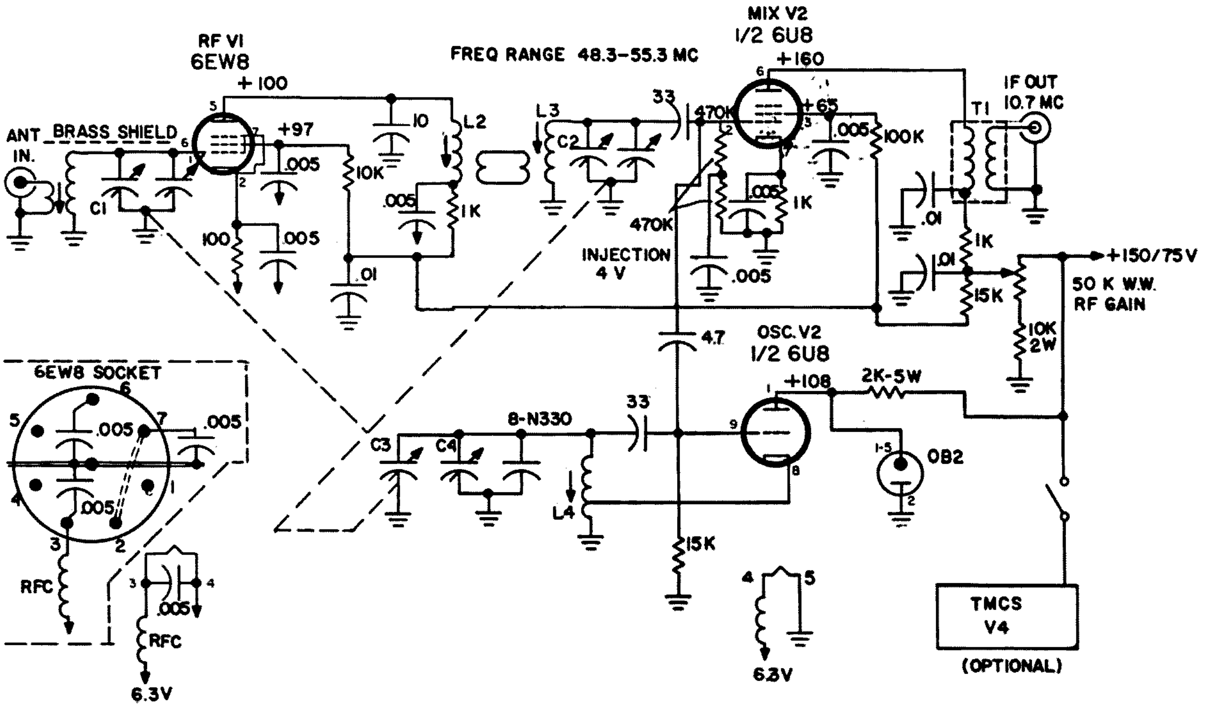
The 6U8 mixer grid, 6EW6 rf plate circuit and the antenna input coil use link coupling. The plate of 6U8 mixer feeds into a Miller No. 1463 10.7 mc if transformer mounted on the same chassis. This frequency of if was chosen for good image rejection and flat response over the tuning range of 7 megacycles. However, to make the module "ham" practical, the output must be fed into a receiver with a 455 kc or lower if strips for selectivity. If this unit is to be used as part of a new receiver, the output of the 10.7 mc transformer can be fed into a mixer such as a 6BE6 with crystal controlled oscillator and converted to the desired low frequency if.

The triode section of the 6U8 is used as a hartley oscillator and tunes through the range of 7 megacycles by 10.7 mc above the incoming signal. Oscillator plate voltage is taken from an OB2, miniature 108 volt regulator for stabilization.

Construction

The entire front-end module, including the TMCS, is built on a home-brew aluminum chassis measuring 4½ x 5½ and ½" deep. A plain plate can also be used, if desired, but to make the module rigid, the ends should be turned down. Variable tuning capacitor is a J. W. Miller No. 1460 which is a rugged miniature three gang type covering a range of 5 to 20 mmfd per section. This capacitor was slightly modified by removing plates so that a greater spread of the desired frequencies can be had, and to spread-out the dial calibration. To modify, remove 2 stator plates and 2 rotor plates from the oscillator section (front end) and 1 stator and 1 rotor plate from the other two sections. Mount the tuning capacitor slightly to the right of the center of the chassis, and mount the coils which are wound on Miller ceramic coil forms No. 41A000CB1 between the capacitor and the tube sockets as shown on the photo. V3 in back of the capacitor and on center of the chassis is the OB2 voltage regulator, and to its right is the 6J6, TMCS oscillator and the frequency cultiplier ube. The 1. mc crystal can be seen just below the tube.

In the upper left hand corner, as shown on the top photo, locate the J. W. Miller 10.7 mc,



C_1-C_2-C_3=J. W. MIl n. 1460
C_4=Johnson 15M11
L_1-L_2-L_3-L_4=J. W. Miller ceramic coil forms no. 41A000CB1 ¼" x 11/16" slun tuned.
L_1=6T #20 close wound 3T link
L_2=12T #20 close wound 3T link
L_3=6T #20 lse wund 3T link
L_4=7T #26 bare, space wound (dia. of wire) tap at 3¼ T. from cold end.
T_1=J. W. Miller no. 1463 10.7 mc if transformer
RFC=15T #26 enamel on ½ watt resistor.

Arrows indicate connections made to brass shield

if transformer No. 1463 and the switchcraft 3501FP jacks for if take off, antenna input, and the TMCS output.

The bottom view of the photo shows a brass plate measuring 1½ x 3" which is cut out to fit over the center post of the 6EW6 socket and fastened to the aluminum chassis by 2-56 screws. This plate being the shield, is also used to solder the by-pass capacitors to it as the ground return. This is shown on the schematic and part detail of the circuit. The rf grid coil can be seen on one side of this shield and the other coils on the opposite side. The oscillator coil is to the right of the mixer coil and injection is transferred from the oscillator to the mixer by the 4.7 mmfd capacitor which is connected between pins 9 and 2 at the socket of the 6U8. A Johnson 15M11 oscillator trimmer can be seen below the coil; this trimmer is shunted with a 8 mmfd N-330 capacitor for temperature compensating, and connects to the main tuning capacitor by a bus, as shown on the bottom view.

The APC variable capacitor just below the oscillator trimmer is the frequency adjusting for the TMCS. Stray coupling between the harmonic coil of the TMCS and the rf coil of the converter is sufficient to pick up the signal when B+ is applied to the crystal standard.

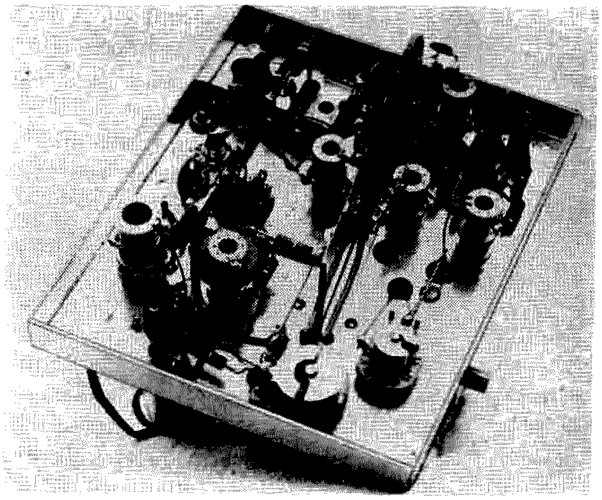
The coil shown at the top in the bottom view of the photo, is the plate tank of the rf amplifier which is linked coupled to the mixed as previously mentioned. Although the photo indicates that the components are crowded, there is sufficient room to work around them due to the narrow lip of the chassis.

Adjustments

After all coils are wound as per coil data and mounted together with other components, apply and check the voltages. Do not exceed the indicated voltages by more than 10% to keep the unit in the low noise catagory. If the voltages are satisfactory, turn power off and proceed with alignment and tracking.

Oscillator Range

To set the frequency range of the oscillator, with the aid of a grid dipper, first adjust the main tuning capacitor for max. capacity and the oscillator trimmer capacitor meshed about 1/3; adjust the powder iron slug in the oscillator coil so that it dips at 59 mc. Now tune the main tuning capacitor to minimum capacity and dip the coil again; it should read 66 mc. If the frequency is higher, add more capacity by rotating the trimmer to bring it down to the right frequency; then go back to



Bottom view showing the location of components. The three coils in the upper right hand corner ore: rf plate coil on top, below is the mixer grid and to its right is the oscillater coil. The brass shield can be seen separatng these coils and the grid coil of the 6EW6. In the lower left hand corner are the 1 mc coil and the multiplier coil of the TMCS standard. The 6J6 socket is located just below these coils. The two variable trimmers in the right hand corner are the oscillator trimmer and the standard trimmer.

the low frequency end and check, adjusting the slug again to 59 mc. Repeat the process by adjusting the trimmer capacitor on the high frequency end and core on the low frequency end until the desired spread is obtained. With the oscillator coil adjusted, go to the mixer coil, but first short out all other coils, by soldering a wire from the hot end of the coil to ground, and proceed in the same manner as dipping the oscillator. In tracking the rf, mixer and the antenna coils the frequency should be 10.7 mc less than the oscillator frequency and should read 48.3 mc to 55.3 mc. It is impossible to be very accurate with the common grid dipper, so close approximation must suffice; but don't let that bother you because the final adjustments are generally made by peaking all coils (excepting the oscillator) on known incoming signals or with the aid of a signal generator.

Adaptability

The front-end can be used in connection with a standard communications receiver that will tune to 10.7 mc and can be done in the following manner. Use a short piece of RG-58U coax between the if output of this unit and the antenna input of your receiver. Tune the receiver to 10.7 mc and leave it set there. This is now your fixed if and all tuning is now made with the tuning capacitor on the module. Suggested way to do the tuning is to use a

velvet vernier dial such as National ACA-1CN or MCN dial to reduce the tuning speed. These generally come as 5.1 reduction ratio and can be bought in most radio stores.

For two meter operation, the front end is used between the crystal converter and the receiver. This will make your set-up a triple conversion or better and will reduce spurious frequencies and images to a minimum. It will also give you that extra gain for those weak DX signals. Be sure that the if frequency of your converter is a 50 mc output; if not, adjustments must be made in your two meter converter mixer and the crystal oscillator.

The front-end can be mounted on a larger commercial chassis with its own power supply or can be mounted in a mini box for good over-all shielding and the power can be supplied by the receiver. Make certain that the receiver power supply is not overloaded; the power requirements are 1.3 amp at 6.3 volts and 40 ma at 150 to 175 volts for the complete unit including the TMCS.

. . . W9DUT

Parts Kit Available

The parts for this unit are available as a complete package from 73, Peterboro, N. H. Order W9DUT-2 Kit $20.00

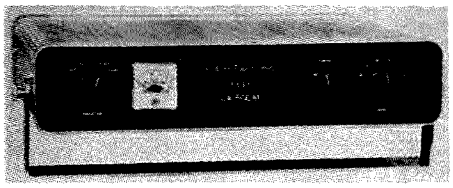
New Products

Byron Airpark?

We've had some unlikely names among our advertisers, but I think this one is a winner. Their product is good enough for you to overlook the name: plastic guy line. If you've ever strung up a dipole you know by now that you can't successfully use wire to hold it up in the air. And string rots after a while, dropping everything.

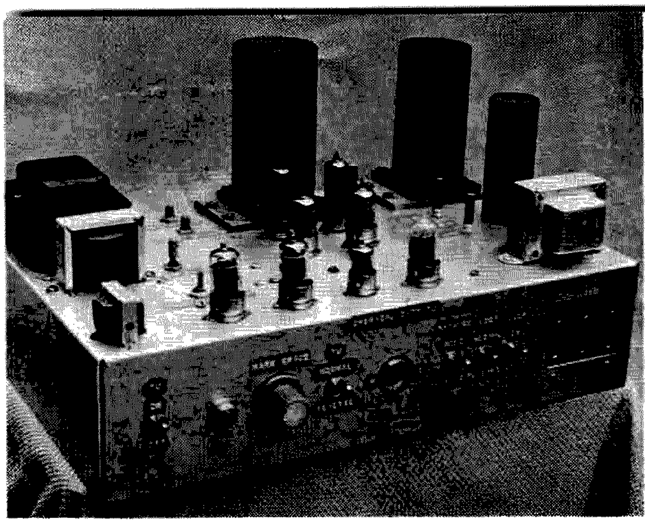
This plastic line really comes into its own on towers where you want to keep away from wire guys which will disturb your radiation. Particularly if you are going to put in an inverted Vee antenna you will want to use plastic guys, elsewise you can forget the whole idea.

Byron A. has several different sizes of lines available and almost any color you can stand. The stuff is a lot simpler than regular guy wire to use too. You don't have to fuss with insulators, turnbuckles or other fittings. It won't wear out, won't stretch and will last longer than your tower. Drop a line to Byron Airpark, RR3, Xenia, Ohio for specifications.



Sideband Linear

P & H Electronics has just announced a new linear amplifier. This job should work well with almost any of the sideband transceivers on the market to produce a 1000 watt PEP signal either at home or in the car. The small flat construction is designed for mobile use. The price is only $189.95 not including the high voltage supply. It uses six tubes in a grounded grid circuit. Drop a line to 424 Columbia Street, Lafayette, Indiana for more info.



Chemical City T.U.

Jim Kortge K8IQY
Jerry Kortge K8JAC
551 E. Wodsworth Hall
Houghton, Michigan
Photo credit: Don Roberts K8VXX

This article is an attempt to present a teletype terminal unit that is better than the majority of the T.U.s presently being used by amateurs on RTTY. This converter, called the "Chemical City T.U." after the chemical city of Midland, Michigan, features provisions for copying on either mark or space or both. It also permits copy of signals too low in the noise to be usable printable material except by the very best terminal units, which are usually not available to the average ham. The "Chemical City T.U." will out-perform both the W2JAV and W7CJB terminal units from which much of the circuitry for this converter was derived.

Our initial idea for this converter came after we had used a W2JAV, modified by W5ANW, T.U. on the air for a month. The only complaint against this converter was that it did not print signals that were down in the noise. Aside from that, it was a very good converter. However, it was thought that something could be done to improve the ability of the modified W2JAV when it came to copying noise covered signals. A partial answer to our problem came in an article by W7CJB in which he described a converter that utilized a balanced detector with a long time constant filter on the output which would eliminate a great deal of noise. With these two circuits at hand and several of our own ideas which we wished to try, we designed and built the terminal unit which you see in the pictures.

The first of our ideas appears at the secondary of the input transformer. As can be seen, we utilized a pair of IN2071 silicon diodes for the first stage of limiting. These diodes, because they have the property of passing one fourth of a volt before they start to conduct, seemed ideal for limiting purposes without the use of bias voltage and the associated resistors necessary with the conventional diode limiter. The use of these diodes results in a total voltage of one half volt peak to peak on the grid of the 12AX7 second limiter amplifier. With this arrangement, the signal output from the 12AX7 is constant between the level where the signal is just audible to the ear to full output from the receiver.

The signal voltages then pass through a 12AU7 amplifying stage; one triode section for the mark channel and one triode section for the space channel. In the plate circuit one will note that the pair of transformers drive the 6AL5 balanced detector. The output of the balanced detector is used to feed three different tubes in the converter as can be seen in the schematic.

The first tube fed by the detector is another 12AU7 which is a dc amplifier and keyer for the mark and space coupling. Output from the detector also feeds the 12AU7 preceeding the detector. And finally, the detector voltage is fed to a 12AX7 inverter tube which begins the process of converting the trailing edges of mark pulses to space pulses and space pulses to mark pulses making it possible for one to copy on either mark or space when one of the two signals is not present for reception.

The second idea which we contributed to this converter is the feedback loop which is associated with the application of voltage, derived from the output of the 6AL5, on the grids of the first 12AU7 amplifier. This voltage causes three things to take place. First, the dc component from the output of the 6AL5 provides bias on the grid of the 12AU7 giving the converter a small amount of automatic gain control. This gain control begins operating

when the signal into the limiter is of lower amplitude that the operating point of the limiter, at which time, the automatic gain control takes over to hold the signal through the converter at a more constant level than would normally be had if it were not present.

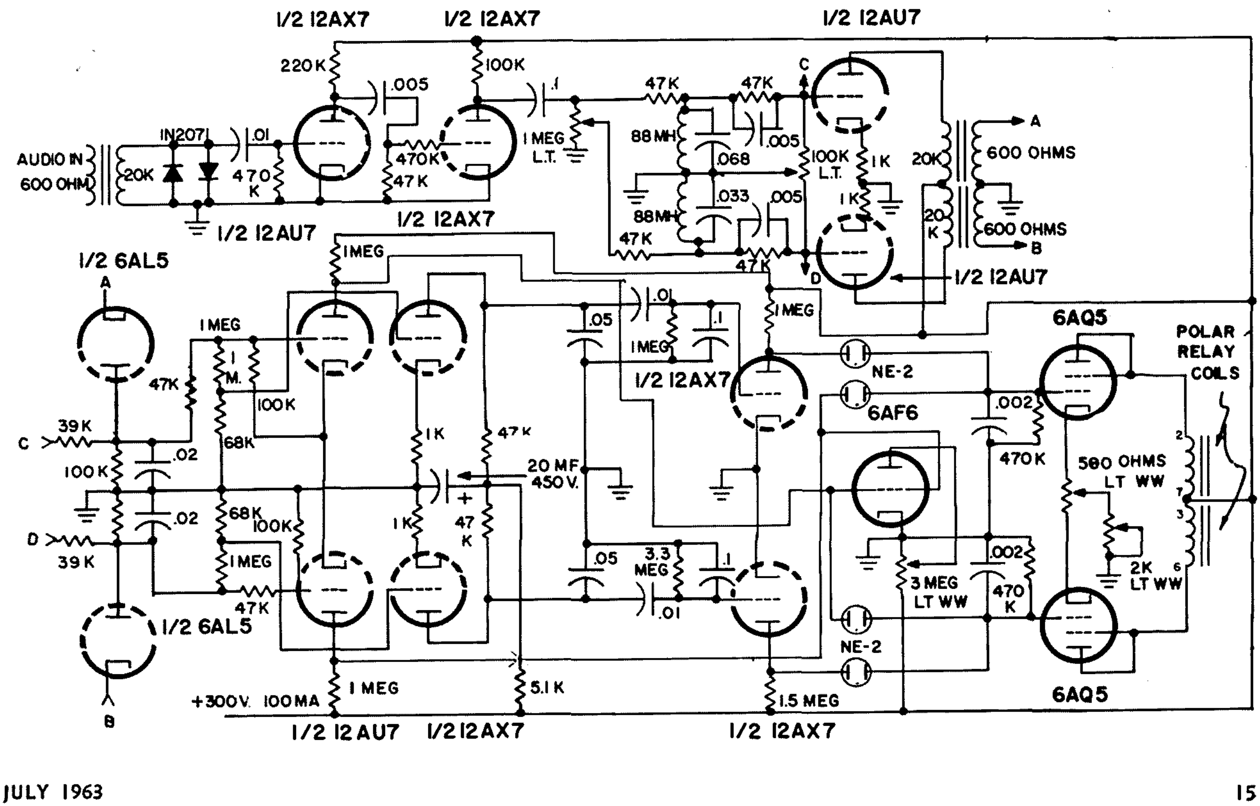
A second benefit derived from the voltage on the grid of the 12AU7 is that of giving pre-emphasis to the pulses as they pass through this stage before going on to the 6AL5 for detection. A close look at the operation of the detector will show that the voltage at the output of the detector is a function of the signal at any given time. When the signal changes from mark to space and back to mark again, the bias on the grid of the 12AU7 amplifying tube changes with respect to the incoming pulses. This action produces a more definite pulse at the grid of the 12AU7.

The dc output from the detector, which is actually negative half cycles of the audio going into the detector, is utilized in this converter, as in other converters, to operate the various keying stages. However, along with this pulsating dc voltage, there appear negative pulses of noise which will trigger the keying stages giving erratic operation on marginal signals. Feeding these negative pulses back into the grid of the first amplifying stage tends to cancel out the positive pulses of noise appearing at the grid, reducing the noise figure of the system.

A 6AF6 dual eye tube was incorporated in the T.U. to aid in tuning the signal in correctly. The grids of the 6AF6 are fed directly from the first 12AU7 keyer tube. The 3 megohm potentiometer is used as a voltage divider in the plate circuit of the 6AF6 to set the closure of the shadows to a hair line when the limiter is saturated.

The parts layout is not critical except the input of the T.U. should not be too close to the output of the 12AU7 amplifier as it may tend to oscillate. The only critical part needed in duplicating this converter would be the type of transformers used to feed the detector. On our model we utilized a pair of surplus transformers that we had on hand. They have a 20,000 ohm primary and a 600 ohm secondary. Almost any kind of transformer could be made to work. However, the 47K resistors at the output of the detector, which feed the 12AU7 keyer, would have to be changed and the voltage dividers feeding the 12AX7 inverter tube would also have to be changed. Other than the few suggestions that we have just given, one should have no trouble duplicating our results.

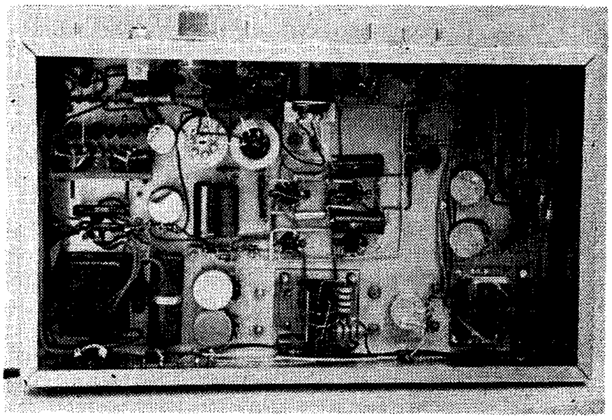
Finally, we might say that there are many more improvements that could be made on the mechanics of this circuit which would make the converter even better. The addition of a comb filter at the input would reduce even further the noise entering the T.U. Also, one could use band pass filters at the input for greater suppression of unwanted signals and for greater ease in tuning. The addition of an axis restorer to hold the machine in absence



of any signal and the addition of a mark-space axis computer, to move the operating point of the detector half way between the mark to space peak amplitudes, would also improve performance.

As an aid to anyone who would like to construct a copy of our converter we have included pictures of the one we built. We might mention that this "Chemical City T.U." also contains an integrated loop supply on the same chassis which makes a very and useful piece of apparatus. One can see in the pictures that there is room available for future improvements and these will come with time.

The "Chemical City T.U." is by far a long ways from being the ultimate in RTTY converters. Our main purpose in designing it was to combine two good converters into a single unit which would out perform either by a wide margin. We feel we have suceeded in doing this. No originality for the basic circuits is claimed. Our ideas and improvements, however, have transformed a feasible idea into a working unit that performs ex-



cellently on the crowded ham bands and has been doing so for the three months we have been using it.

We are sure many RTTYers, whether old or new, will find this T.U. just the RTTY converter they have been looking for. To those who build this terminal unit, we would appreciate hearing your comments and any suggestions or other ideas which could be incorporated into a future "Modified Chemical City T.U." . . . K8IGY . . . K8JAC

Low Ebb in the Sunspot Cycle

Bill Ashby K2TKN
Box 97
Pluckemin, N. J.

It had been a particularly bad night on two meters; the guys that were far enough away to be interesting kept getting excited and increasing speed so that my Sync Detector wouldn't follow (see 73 Sept. 1962) and two locals persisted in rag-chewing on my reject channel. Even after all the publicity, a few die-hards couldn't get it thru their thick skulls how 1's, 2's and 3's were working 6's and 7's on TWO Meters every night. The idea of cranking the beam around toward Europe was not too inviting, the QRM from those Iron Curtain 220 mc club stations calling blind since they found out that we could hear them would be just too much. Before pulling the switch, decided to check 432 mc aurora to see if the same old gang was on tonight as usual—they were. You would think that after a year some DX would get interested—after all, this GI3, SVØ, RA1, and KKL7 gassing away couldn't read a signal more than 30 db under the auroral noise if they tried, some of them were even using superhets! Thirty minutes of copy of this crud just proved how bad things were, it must have been weeks since there had been a decent opening, so the only thing left to do before calling it quits was to re-calibrate the receiver. After shifting the cables around to get the high frequency front—end on the polar antenna and cranking in the usual deviation and hour angle settings —nothing! Banging the varactor multiplier string a few times with the ash tray, things began to sound normal—one of these days I'll get around to fixing that thing right. Then tuning around the right side of 1245 mc for a bit, there it was—eight ball in the corner pocket. Ever since we had started peaking up the receivers on the hydrogen line emission from the sun bouncing off the moon, things had been a little livelier on the VHF-UHF bands. There had only been two threats of

suicide at the last club meeting when the letter from the FCC was read, thanking the US Amateurs for so generously giving up all rights to their historic bands below 144 mcs, as recommended by the ARRL to give more channels to the terribly overloaded citizens bands. Since most of these CB boys were running at least a KW peak of old-fashioned SSB they did need the room. One thing for sure, now the boys at HDQs would finally have to re-write the Handbook.

Might as well see if Sam or Tommy are on 1296 mcs—XZQ! #&$! That durn receiver is acting up again. Banging on it hasn't helped. Up - down, up - down, up - up - down - up, over and over again. Hey! That's CQ CQ CQ CQ! Some local must be overloading my front end—no, it peaks up on the moon. No coherence at all, just pure noise, half a mc wide, and almost -200 dbm strong! Some nut must be playing around with the world's biggest spark gap. I haven't heard anything like this racket in years. "CQ CQ CQ CQ CQ de 8X&DN ARK." What kind of a lid is this, 50 CQs and he signs once while I was diddling with the integration so I missed his call! Let me see—if I swipe some sync info from the TV generator to modulate the driver and short out the filter chokes on the final power supply, my note will be rough enough so that it could be copied with a tunnel diode, Ha. Boy, that used to clean the 6's out of the pile-ups on the low end of twenty. Now the final is up to full power with no more than the usual smoke —"QRZ QRZ QRZ DE K2TKN, etc." Nice and snappy, three by one calls just for style. Careful, don't let the speed drift up or he will never copy, even with these strong sigs. One second dots, three second dashes, that should raise Old Harry Himself. Lengthen out the dashes on the sign out—a Banana Boat Roll got me some choice contacts in the old days, why not now?

Where did he go? There he is—almost two megacycles lower—that xmtr must be an old Tuna Clipper Square-D! Listen to him roar! "S2 S2 S2 S2 de 8X&DN R R R R S2 S2 QRZ QRZ QRZ de K2TKN hv bn rcvg misc slow-wave sigs fr ovr 13 yr orbits abt yr star bt u frst 2 use planetary resonance 2 modulate yr star radiation giving zero delay—vy fb sigs ga.

S2 S2 S2 de 8X&DN QRZ QRZ QRZ de K2TKN S2 S2 S2 de 8X&DN ARK." Turn up the variac, there be no complaints about power on this one—"8X&DN de K2TKN." You know this isn't such a bad night for DX after all!

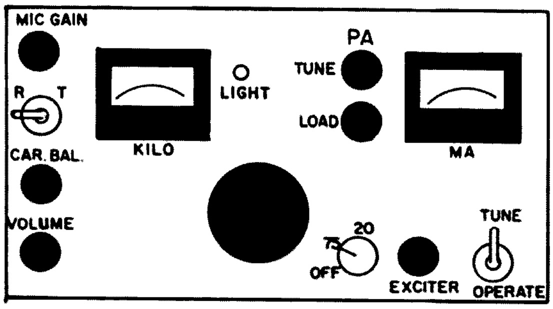
"8X&DN S2 S2 de K2TKN" "8X&DN de WIBU" "8X&DN de KH6UK" "8X&DN de DL3FM." Listen to that tail-ending pile-up!

. . . K2TKN

Two Banding The Swan One Bander

Dave Sherman W8DHZ
95 Dexter Drive
Hilliard, Ohio

After purchasing a Swan 175 I came to the conclusion that converting to 20 meters would be a simple matter since the sum of the VFO plus the 5775 mc SSB signal would be approximately 14 mc upper SB.

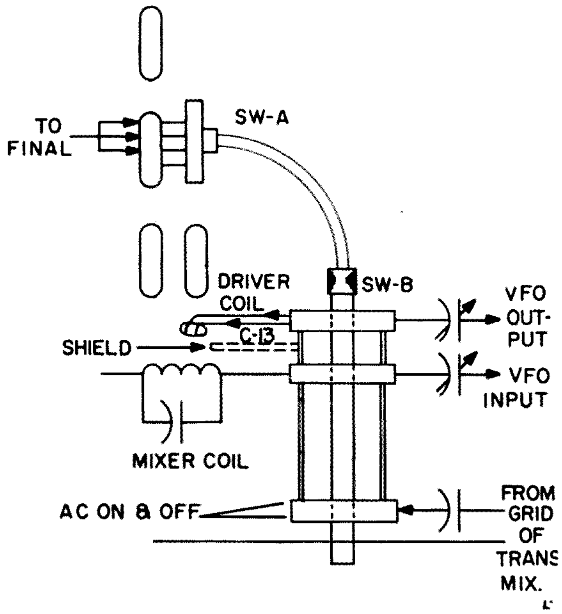


However I was determined to stick to the following rules:

(1) Do all band switching with 1 switch
(2) Use an existing control position on the front panel, therefore not alter the appearance of the Swan.

I decided to use the power on-off switch location for my band switch and include power on-off as a position on the band switch. To do this coil L4 must be moved over a slight amount to clear the band switch.

The band switch was a miniature Centralab PA 300 series 6" long with 3 ceramic decks 2 pole 6 position. The final switching is done with a single deck 2 pole 6 position coupled to



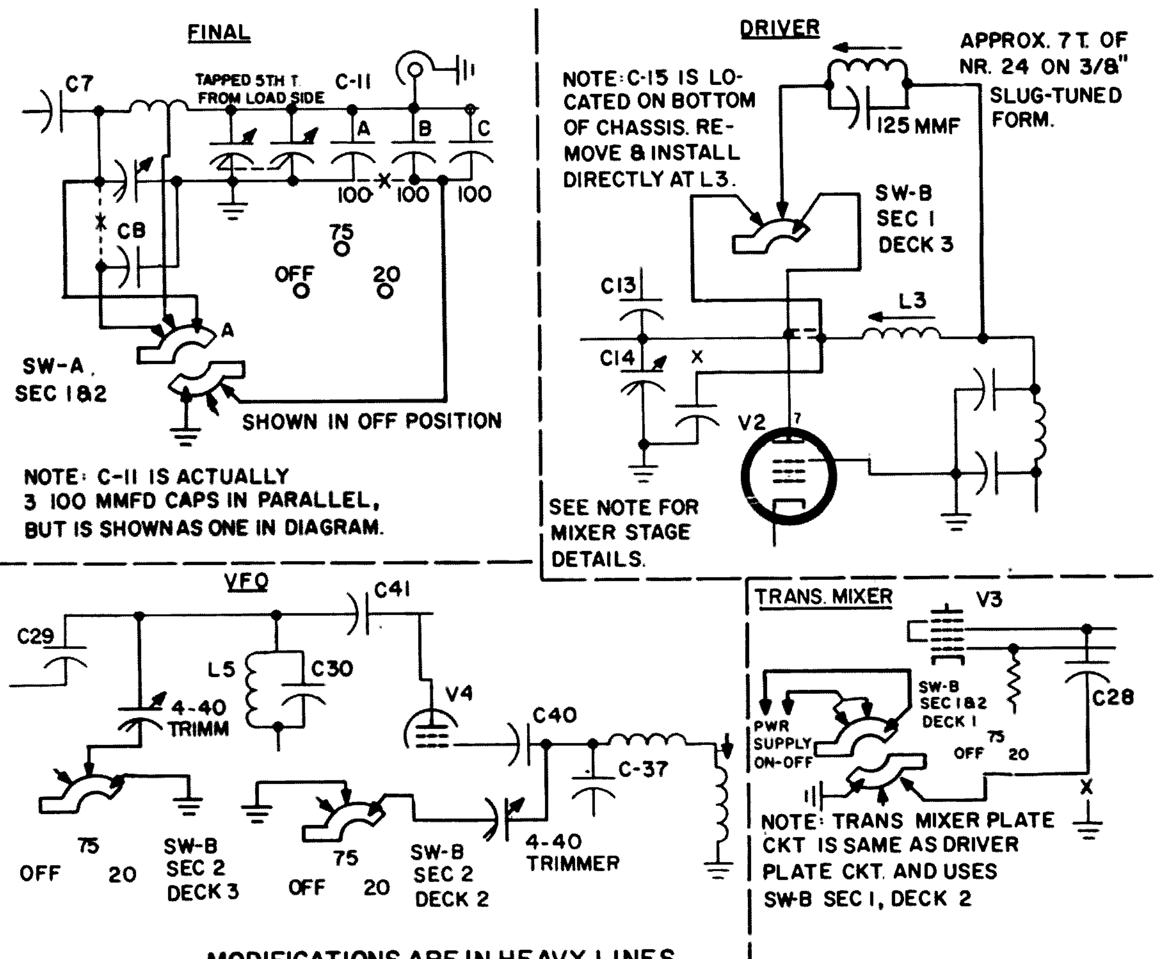
the band switch via a flexible shaft. A longer band switch could be used and include the final switch on it.

The 20 meter coils for L3-L4 are mounted beside the 75 meter L3-L4 coils. A hole must be drilled in the chassis to allow the 20 meter driver coil to be connected to the band switch and another hole drilled to bring the lead from capacitor C13 (which is located on the 6DQ5 socket) to the high side of C11.

To prevent the possibility of oscillation I added a small shield partition between the switch deck that switches the x-mitter mixer and the deck that switches the driver.

After making all modifications, switch to 20 meters and adjust the VFO padder which you added until you have 20 meters coming in. This can be done with a GDO. Then with the exciter tuning in the upper half of its range adjust the two 20 meter coils for max signal. Then switch to transmit and with an output meter coupled to the final, insert a little carrier and peak the coils to max output in the middle of the 20 meter band. Then adjust the VFO output capacitor, which we added, for max output as indicated by the output meter. If any trouble is encountered check all tuned circuits with a GDO.

The modification is very simple and for this reason the instructions are brief. No one with



MODIFICATIONS ARE IN HEAVY LINES

any building experience should have any trouble with the modification.

The only disadvantage to this system is that with the long lead coupled to switch the VFO input capacitor the stray capacity is enough to throw the calibration off for the 75 meter band a small amount. This could be cured by coupling a switch deck over close to the VFO. Since I only work the upper half of 75 the error is very small upon adjusting C-34 after the capacitor is installed. This also requires going back and adjusting the 20 meter VFO capacitor again.

The dial can be calibrated by rotating the dial 180° and calibrating the blank dial for 20 meters with a good signal generator. The band spread is just right to cover 14.20 to 14.350.

I would like to thank John Collins and Miss Ruthellen Hutt whose assistance made this project and writeup possible. . . . W8DHZ

Letters

Dear Wayne:

As of October 1962 W4KXQ and K4GRY were the first in the State to have AFSK RTTY activity on 52.6 mc FM. Now we have WA4EQG and W4PZY in the local area plus others in Lynchburg, Roanoke, and Waynesboro, Va., now active. We hope to have a repeater going for AFSK FM on 52.6 mc soon and with added antenna height and preamplifiers ahead of the receiver to be ready for some good DX when the band opens up. We will sked anyone and help anyone interested in joining our fine group. K4GRY has a model 15, a model 14 REPFR and TD, a W2JAV converter—a SFO regenerator and a 50 watt LINK FM receiver and transmitter. W4KXQ has a model 15, a Western Union TD, a 14 REPFR and a model 14 strip printer with a Motorola 80 D for transmitter and receiver. KXQ's antenna is about 70 foot high. WA4EQG has simiilar equipment with a W2JAV TU similar to KXQ's. We are now active with autostart and will be ready to work anyone at just about any time conditions will permit.

George P. Oberto K4GRY
Richmond 26, Va.

Dear Wayne,

I am somewhat disturbed by the adverse comments that the double sideband suppressed carrier article by W3PHL (Feb. 73) has been drawing. Per se I am not against controversy, but to meet scientific argument with invective is childish. This is especially true as the author took considerable pains to supply a good bibliography for anyone wanting to pursue the validity of his argument further. Certainly none of the detractors have bothered to challenge the validity of the concepts involved, and perhaps their letters would make a good starting point for a case for demanding a greater breath of technical understanding from the fraternity. I suspect that a great deal of the references to "doubletalk" and "junk" arose from a basic misunderstanding of the principles of information in electromagnetic communication.

J.C.B., Ottawa.

The Buck-a-watt Six Meter Transmitter

Tuning indicator parts kit available

Robert Rose K6GKU
9332 Sage Avenue
Arlington, California

As fads come and go and interests change, this author has learned one very important fact. To run out and buy commercial equipment to meet each new demand can lead to the state of instant poverty. The answer—homebrew as cheaply as possible. A recent urge to try six meters produced the rig described herein. If you are a homebrewer who would like to get on six meters without spending a lot of money and still want to put out a signal to be proud of—this rig will do just that.

The transmitter is a plate modulated, 15-20 watt rig which is made up of reliable circuitry and low cost components. It also incorporates a novel (but not new) method of monitoring the oscillator/tripler output, the doubler output, the final tuning, and the modulation, all simultaneously. With any kind of junk box at all the transmitter can be built for about a dollar a watt.

Numerous articles on 6 meter transmitters were read with the same result—something was lacking. Either the modulation was not adequate, the power output was too low, the components were high priced, or the oscillator doubler stages used a triode-pentode combination. In general the authors junk box would have been of no help at all. It was finally decided to use circuits from several sources to get what we wanted. The final product is the 6 meter transmitter shown in Figure 1.

The 6AK5 oscillator/tripler is a modified Pierce circuit which makes use of economical 8 Mc. crystals. The 25 Mc. output drives the 6AK5 doubler stage. Both of these stages use a parallel resonant tank circuit. The use of variable capacitors in these tank circuits makes their tuning unique and smooth.

The output of the doubler stage is mutually coupled, through a series resonant circuit to the final 2E26 which is operated as a straight through amplifier. The mutual coupling between L2 and L3 is achieved by placing the axis of the coils in parallel. The spacing of the two coils is determined by the point of maximum drive to the 2E26 as the position of L3 is varied. Experimentation showed this spacing to be about ½ inch. The use of mutual coupling into the final and link coupling on the final output proved to substantially reduce the TVI problem.

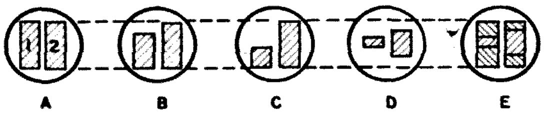
The 10 watt modulator, shown in Figure 1, consists of a 12AX7 used as a two stage pre-amp and a 6L6 final modulator tube. The input was designed for use with a crystal microphone and the output provides plenty of punch for the 2E26. The modulation transformer used was a surplus modulation transformer taken from the ever faithful 522 and may be obtained from most surplus stores.

The power supply is strictly conventional in nature and any supply capable of 300 VDC at 150-200 ma and a 6.3VAC source will do the job nicely.

There is little to be said about the construction and layout of the transmitter unit. These may be determined by the builder to suit his needs. The coils LI, L2, and L4 are the air wound variety and were checked with a grid dip oscillator to ensure resonance in the proper frequency range.

The variable capacitors CI, C2, C3, and C4 were all the surplus APC type with shafts soldered on C3 and C4. Except for the observance of standard VHF construction practices, there is nothing critical in the building of this rig.

The novel method for tuning this transmit-



6AL7 Indicator Presentations

Figure 2a shows the 6AL7 display with no signal input. The output of the oscillator/tripler stage will move Bar 1 down from the top. Vary capacitor C1 for maximum depression of Bar 1. This indicates maximum tripler output as shown in Figure 2b. The output from the doubler stage will move Bar 2 down from the top. Varying C2 for maximum depression will indicate maximum doubler output as shown in Figure 2c.

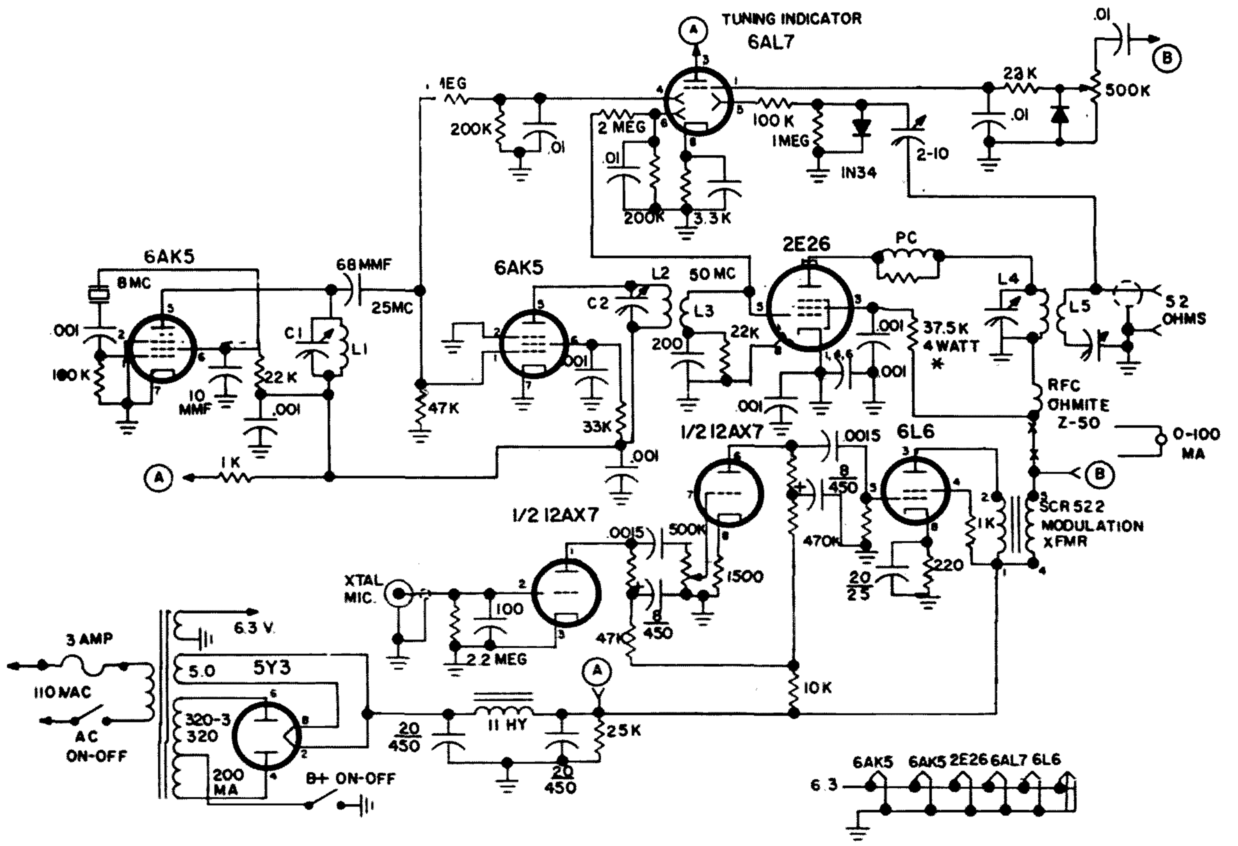
ter was taken from an article written by Don Stoner in the Nov. 1957 Brand X magazine. The tube, a 6AL7, is not the standard type of "eye" tube such as the 6E5. The 6AL7 presents two green bars, the height of which is determined by the signal produced by the output stages monitored. To save space the theory of this tube's operation will not be discussed here.

Learning to read the tuning indicator is a little tricky at first but once it is mastered, the feature of being able to see the output of the oscillator/tripler stage, the doubler stage, the final tuning, and the modulation simultaneously will make the 6AL7 a must item in future rigs. Figure 2 will help in tuning the transmitter.

Tuning the final for maximum output will move both Bars 1 and 2 up from the bottom. For those who worry, it has been found with a milliammeter inserted in the plate circuit, that the dip indicated on the 6AL7 will coincide with the dip of the plate current meter. Figure 2d shows the 6AL7 presentation with the tripler-doubler stages peaked and the final dipped.

All that is left is to apply the modulation. Advance the audio gain control and apply a signal into the microphone input. On the modulation peaks, the 6AL7 presentation will expand both Bars from the top and bottom. The amount of the expansion will depend on the amount of modulation. If you are lucky enough to have an oscilloscope, the face of the 6AL7 may be calibrated, by percentage, with a grease pencil. Figure 2e shows the presentation with the transmitter fully loaded and with modulation.

There is one point to be noted about the leads used to couple the tripler and doubler



L1—12T #20—½" dia ⅝" long
L2—7T #20—½" dia ½" long
L3—7T #20—½" dia ⅜" long
L4—3½T #14—¾" dia ½" long

L5—2T #14 cold end of L4
C1, C2, C3—25 $\mu\mu$fd varioble
PC—5T #20 on 100 ohm resistor
*4—150,000 1 watt in parallel

signal to the 6AL7. The 1 megohm resistor to pin 4 of the 6AL7 should be connected directly to pin 1 of the 6AK5 doubler. The 2 megohm resistor from pin 6 of the 6AL7 should be connected directly to pin 5 of the 2E26. This will reduce any unwanted radiation through these leads.

This transmitter has been in operation about three months now and the signal reports received have been very gratifying. Reports on the audio indicate that it is clean and packs plenty of punch. Inasmuch as the author is living in a rented duplex, the choice and altitude of antennas is limited and little DX has been worked. It is felt, however, that with a beam, this rig will perform along with any in its class, either commercial or homebrew. So start digging in that junk box. You probably have most of the parts already.

. . . K6GKU

Bibliography

Simple Transmitters for 50 and 144 Mc.; Simple Transmitters for 220 and 420 Mc.—The Radio Amateur's Handbook, 38th Edition 1961. Pages 435-438; Pages 441-442.

Donald A. Smith W3UZN—8 Mc. Crystal Modification, 73, January 1961.

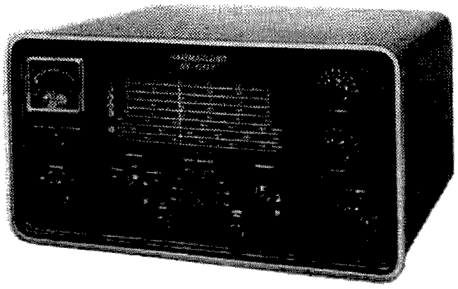
Donald L. Stoner W6TNS—The Glass Eye, CQ, November 1957.

Parts Kit Available

The parts for tuning indicator are available as a complete package from 73, Peterboro, N. H.
Order K6GKU Kit $7.50

73 Tests

The



Hammarlund HX-50

When Hammarlund announced the HX-50 some months ago we at 73 anxiously read the literature to get an idea of what was in the works. The ads looked awfully good so you can imagine how excited we were when we finally got word from them that a unit could be spared for a quick editorial evaluation. It is pretty difficult to take a rig and lend it out for a few weeks when you have distributors all over the country phoning, sending telegrams, and trying in every way they can to get you to send more rigs.

Possibly due to the built up interest here resulting from the HX-50 ads and partly curiosity as to what kind of job Hammarlund had done on this sideband transmitter after all these years of sticking to receivers, the box was open before it hit the ground after being kicked off the Express truck and the HX-50 was being carefully scrutinized and exclaimed over.

As the Express truck turned out of our driveway the HX-50 was warming up for its first contact. During the next few hours it racked up many SSB contacts on 75-40-20 meters, including some garden variety DX, and got a good workout on 20 and 40 CW with W1MEL at the bug.

During the next few days we went over the rig carefully, feeding it into different antennas, checking it with a wattmeter, frequency standards, oscilloscope, and all that. We compared our tests with the advertised specs and could find no place where Hammarlund was not guilty of understatement.

It would be a shame if you read all the way through a test report on a piece of new gear without knowing just what it was you were reading about, so let's take a close look at the HX-50. The HX-50 is a combination SSB/CW transmitter which covers all of the regular ham bands, 80 through 10 meters. It will also cover 160 meters with an optional kit. It can also be used for the MARS or CAP channels with a crystal or external VFO. There is provision for three crystal controlled frequencies, external and internal VFO with one switch.

It is rated at 120 watts PEP, 90 watts dc input on sideband or CW and about 25 watts on AM. It has a built-in antenna relay, a great plus in a transmitter for it is something that you've got to have to operate and which is seldom found in rigs with the result that you usually have to buy a rather expensive relay and wire it in the circuit, giving you a lot more wires to drape around the shack.

Naturally the HX-50 has Vox and push-to-talk. The keying is time sequenced and adjustable. The VFO is not only quite stable but easy to read and very accurate due to the built-in crystal calibrator.

It would seem that the hams down at Hammarlund have thought of everything possible. If they've forgotten anything then it has escaped us too for this rig seems to work just fine and do everything you could ask, whether you be CW of SSB op. The $399.95 price is mighty low by today's equipment standards and makes it possible to have a pretty fancy ham station without a tremendous investment.

. . . Wayne

K6LSX San Jose, Calif.

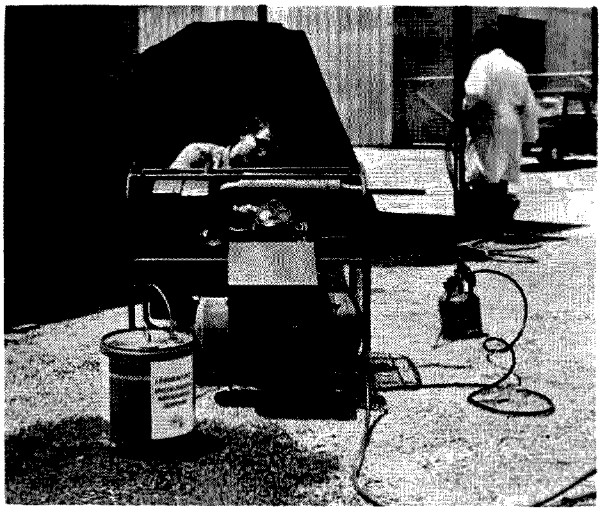
Field Day

The Sidewinder's Radio Club, K6LSZ, held it's annual field day exercise in a saddle between Mt. Loma Prieta, site of channel 11, and Mt. Umunhum, Almaden Air Force base radar site. There were 29 operators, 15 stations, and about 50 people, including many YLs and Jr ops.

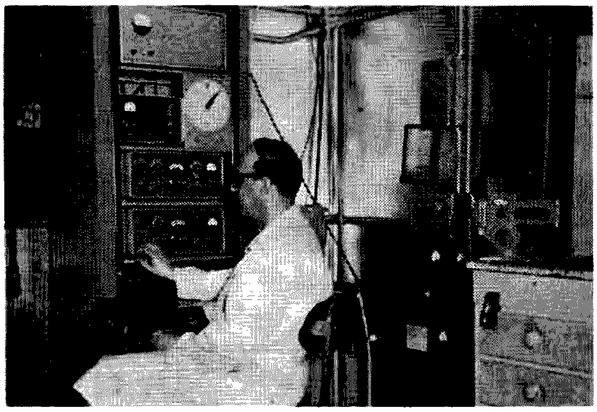
Food was furnished from the club treasury —cold cuts and trimmings, hit chili beans and coffee the entire period, with a steak dinner Saturday evening and bacon and eggs, etc. Sunday morning. This cost about $2 per person.

Paul Barton W6JAT

"Tut" Tuttle WA6LUM confers with county fire captain Bob Olson on fire permits, in the rf lab at Jennings Radio.



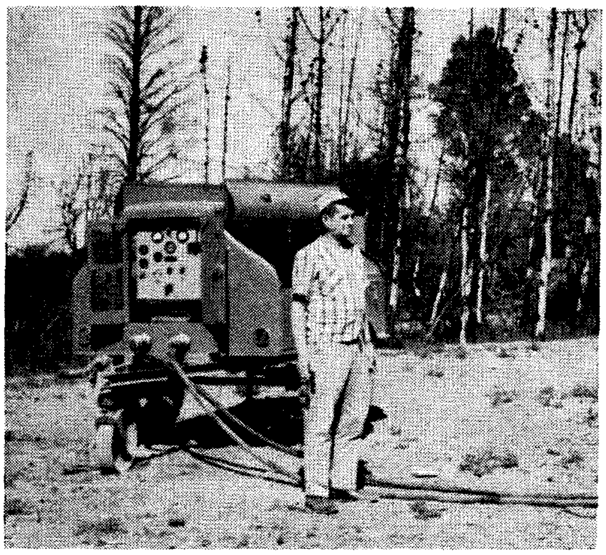
Dave Mauro W6LXK checking out a generator before field day. "Tut" WA6LUM in background.



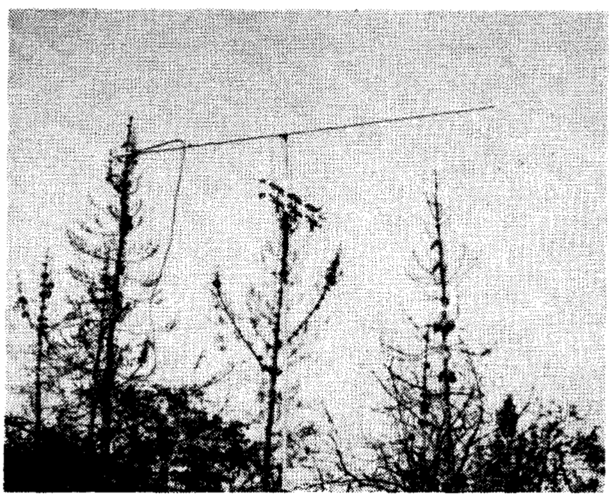
"Buddy" Alvernaz at operating position of K6LSZ home station.

Bob Goddard K6EDU putting up eighty meter antenna.

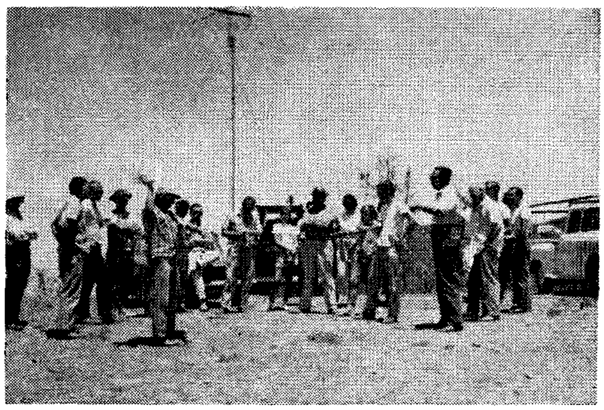
Forty meter tent going up on field day site.



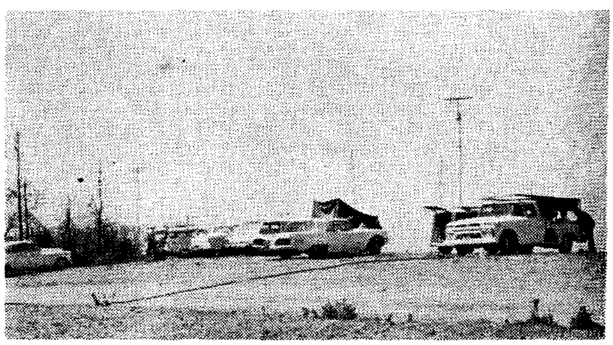
Tut WA6LUM inspects power cables from 7½ KW field day generator.



220 mc and 432 mc field day antennas.



All gear set up and working. Final briefing at 11:57 local time by WA6LUM. Count-down at 11:59 ¾ . . . 4 . . . 3 . . . 2 . . . 1 . . . go!



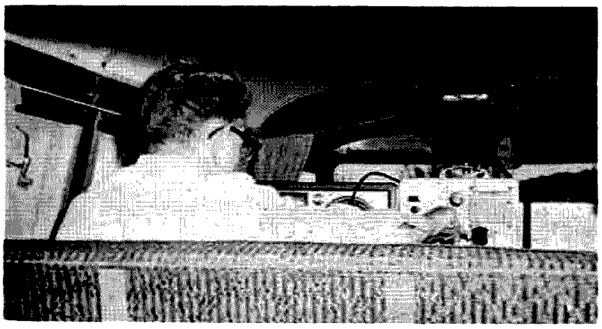
General view of high frequency site of K6LSZ field day operations.

40 Meter operation. L to r: Bert Newkirk W6SIX, Dan Reid K6MZD, Bob Lile.

75 meter position.

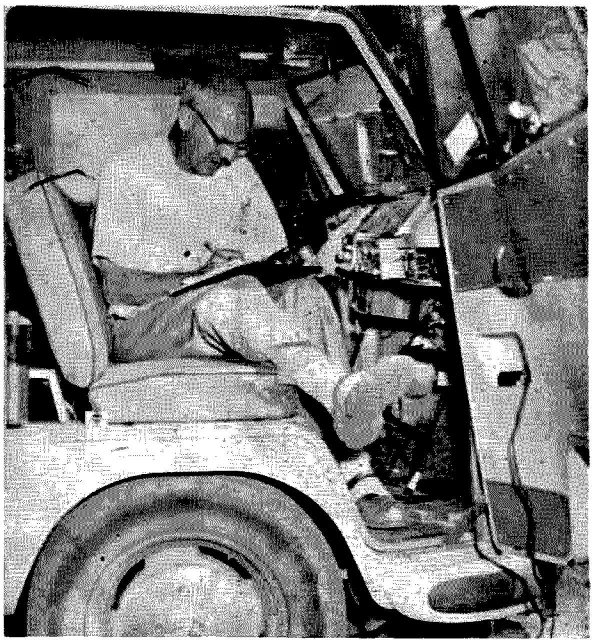
20 meter site. Bob and Dan Reid K6MZD

220 mc and 54 mc operation, Ken Holiday K6HCP and Roy Bortle WA6AVV.



2 meter operation, Lloyd Saxon W6EEX.

Emergency repairs by Bob Hiatt with Keith Nelson watching.



15 meter operation, Hank Plant W6DKZ

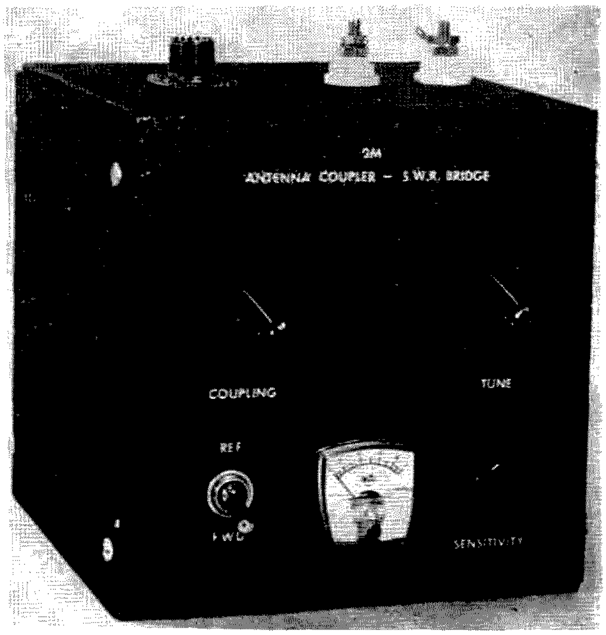
(more on page 32)

(Field Day from page 30)

Russ Bentson K6KLY, 432 mc operation.

Steaks coming up. Bonnie Barton and Paul Barton W6JAT.

Chow down: Ray Mackaman K6PRH, Donna Tuttle, "Tut" Tuttle WA6LUM, Mae Barton K6YSR, Milt Hird K6KTQ, Ernie Vaugh W6SPS, Ernie Peterson W6NNS, Tom Mackaman, Paul Barton W6JAT.



Richard Van Wickle W6TKA
P.O. Box 4051
Santa Barbara, Calif.

Parts Kit Available

Once upon a time there was a ham who could not get the SWR of his feedline low enough to suit him. Blaming his Monimatch, and other SWR-measuring equipment, he threw it all in the fireplace and stalked away. Hence, the expression "He burned his bridges behind him."

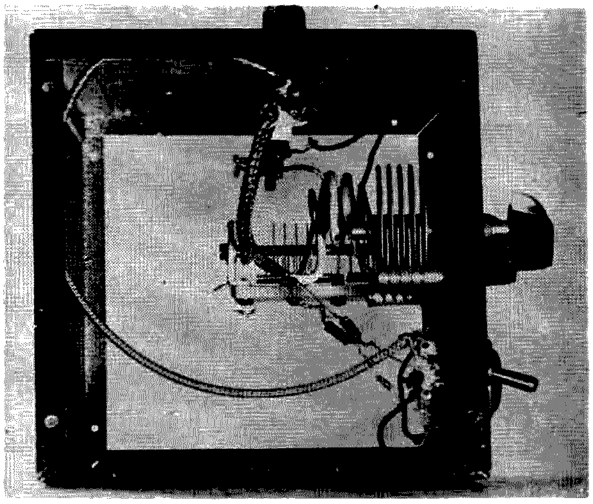
We hope that you will not want to throw this antenna coupler–SWR bridge into the fire. It was developed especially for the two-meter operator who does not like to use coaxial cable as an antenna feedline because of the high attenuation of coax at VHF and who hence prefers open-wire or TV-type balanced feedlines. The antenna coupler will match 52 or 72 ohm unbalanced lines to balanced lines of between 200 and 600 ohms. The SWR bridge is designed to be used with 72-ohm coaxial cable, but can be used with 52-ohm coax, with a simple modification, which will be described.

The manner in which the rf is obtained to operate both the reflected power and forward power bridges is rather unique. Coils are

Two Meter Antenna Coupler and SWR Bridge

wrapped around the insulation of the center conductor of the coax, to provide both inductive and capacitive coupling. The standard arrangement for obtaining rf in reflected power meters is either by running a fine wire between the coax center conductor and the shield, or by running two conductors parallel to the center conductor, and using one of the conductors for the forward power pickup, and the other for reflected power. Both such arrangements are quite good up to about six meters, but at higher frequencies the picture changes. After much experimentation I concluded that the capacitive/inductive/coil coupling arrangement was the most satisfactory for two meters —at least in my own application. This system does not appear to cause an appreciable impedance "bump," and the measured power loss resulting from use of the two bridges is less than one-half watt.

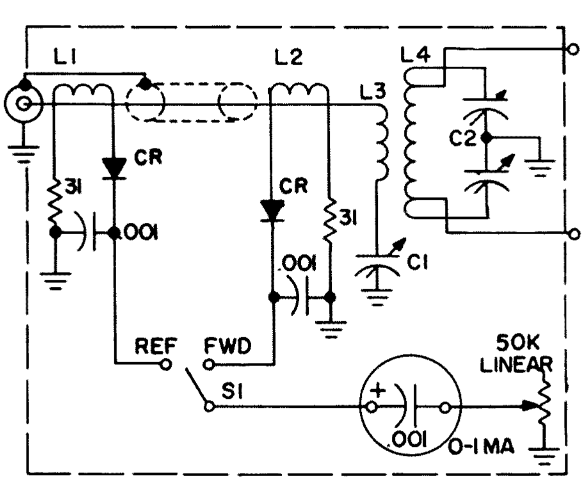
The accompanying photographs show the manner of front panel layout and actual construction of the coupler and bridges. The reflected power pickup coil is wound on the center conductor insulation close to the point



Interior of the two-meter antenna coupler—SWR bridge. The forward power pickup coil can be seen at the center of the unit. The two resistors shown make up the required 31 ohms. The forward power bridge is connected directly to the SPDT switch, while the reflected power bridge (top center, directly below the input connector) is connected to the switch through a length of shielded wire.

where the coax enters the cabinet; it consists of six tnrns of #26 enameled copper wire, wound clockwise. The shield braid of the coax does not cover the pickup coils. Rather, a heavy, low-inductance length of shield braid, approximately ⅝ in. long, connects the coax braid, leaving most of the pickup coil exposed. Completely shielding the pickup coil will decrease the rf pickup.

It should be pointed out that if the coils are not wound in the proper direction, and the resistors and diodes not connected to the proper ends of the coils, the bridges will not provide the desired indications—i.e., the reflected power bridge will read forward power, and vice-versa. The forward power pickup coil also consists of six turns of #26 enameled copper wire, but it is would counter-clockwise



around the center conductor insulation. In the case of the reflected power bridge pickup coil, the resistor is connected to the starting end of the coil (with reference to the input end of the coax), and the diode is connected to the opposite end, while with the forward power bridge pickup coil the resistor is at the finish end and the diode at the starting end (again with reference to the input end of the coax).

Let me make it clear that the reflected power bridge will provide relative indications of standing wave ratio—but will not indicate specific levels of SWR. When the coaxial cable between the transmitter and the antenna coupler is properly matched, with the antenna coupler, to the antenna feedline, the SWR will be 1:1 and the meter reading will be zero. The forward power bridge reads, obviously, rf going into the antenna coupler link, and is a valuable aid in tuning the transmitter for maximum power output. It is not in direct relation to the reflected power, as in the conventional Monimatch. My chief concern was to develop a device which would provide a relative indication of SWR, indicate rf output for transmitter tuning purposes, and act as a matching device; this unit does all three nicely.

My two-meter transmitter has a power output of approximately 15 watts, and this device was designed for that power level. If the unit is to be used with higher-powered transmitters, the rf pickup, of both bridges, can easily be decreased by reducing the number of turns in the pickup coils.

The meter is a 0-1 ma. unit, which is made in Japan and stocked by Henry Radio Co. (Butler, Mo. and West Los Angeles, Calif.), selling for only $2.95. It is entirely adequate for this application. The cabinet is a 6 in. by 6 in. by 6 in. aluminum utility box, black-wrinkle finished.

Much tinkering lead to the conclusion that 31 ohms is the optimum value for the bridge resistors, for a 72-ohm line, in this particular unit. It is quite possible that you will find that a value of resistance somewhat different will be required in your own bridge for use with 72-ohm line. For 52-ohm line, cut-and-try will also be required to determine the value of resistance at which the best null is achieved when the coax is removed from the antenna coupler link (within the cabinet, of course) and attached to a 52-ohm dummy load—the same way I determined the optimum resistance for the 72-ohm coax, using a 72-ohm dummy load.

The resistors shown in the photograph are 39 and 150 ohm units (one each in both the

reflected power and forward power bridges) connected in parallel to achieve the 31 ohms. Naturally, if you happen to have a pair of 31 ohm ½-watt carbon resistors (for heaven's sake, don't use wire-wound resistors!) on hand, use them. I happen to have a large supply of 39 ohm and 150 ohm resistors, hence this combination to achieve 31 ohms.

The ratio of reflected power to forward power can best be adjusted by adding or subtracting turns on the pickup coils until a full-scale meter reading can be obtained in the forward position when the transmitter is tuned for maximum power output, and in the reflected power position when both the tuning and coupling controls of the antenna coupler are greatly detuned, with the antenna feedline connected to the antenna coupler output.

Maximum usefulness of the SWR bridge occurs when building or installing a new antenna. A dummy load of the same impedance as the antenna is connected to the output terminals of the antenna coupler, and then antenna coupler tuned for minimum SWR and the transmitter tuned for maximum power output, using the forward power bridge. The feedline from the new antenna is then connected to the coupler, and, without changing any antenna coupler or transmitter controls, the antenna is adjusted for the same minimum reflected power reading achieved with the dummy load.

If you are feeding your antenna with coax, the antenna coupler portion of the unit could be eliminated, with the bridges constructed as indicated. The coax shield braid would simply be stripped back for about ½ inch, in two locations, separated by three or four inches, and the pickup coils wound on the center conductor insulation. The broken shield braid would then be re-connected with a length of heavy braid or wire.

. . . W6TKA

C1—Hammarlund 50 mmf variable, MC-50
C2—E. F. Johnson Dual Section variable, 27 mmf. per section; 167-51
CR1, CR2—1N34A germanium diodes
L1, L2—6-turn pickup coil; #26 enameled; see text
L3—2 turns, #12 insulated, 1 in. dia. ⅛ in. spacing
L4—5 turns #12 tinned, ½ in. dia., ⅞ in. lg; tap 1½ turns from each end
S1—SPDT toggle switch

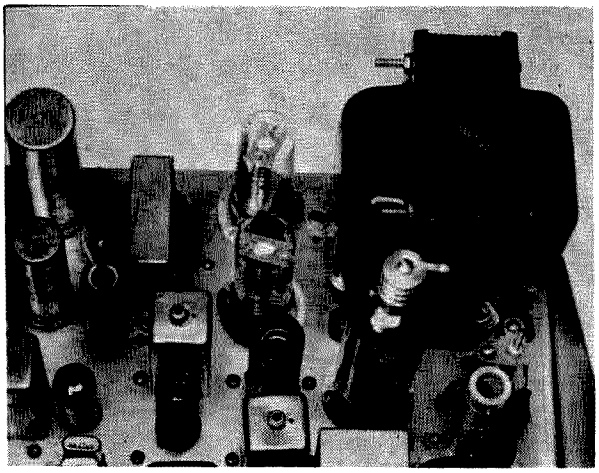
Parts Kit Available

The parts for this unit are available as a package from 73, Peterboro, N. H. Order W6TKA Kit $10.00

Replacement Power Transformer

James Speck W5PPE
1609 Glenbrook Terrace
Oklahoma City 16, Oklahoma

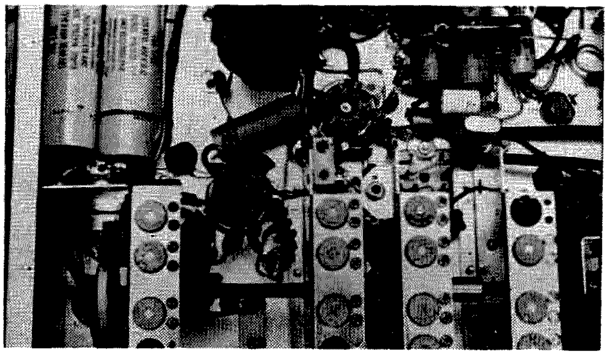
Photos by K5EVI



View of modified power section showing more or less unmodified appearance. The 6DE4s are in the top center of the photo.

One Thursday evening, waiting on a schedule, the power transformer in my Gonset GSB-100 suddenly shorted, putting the station off the air. A telegram to Gonset brought prompt word that they could not ship for four weeks! A look at the circuit showed that the transformer was a special job with a 600-0-600 secondary tapped at 300-0-300 with a 150 volt bias tap. Several calls quickly confirmed that nothing remotely resembling these ratings was available locally. Drastic measures were called for if Saturday's sked was to be met.

Since this same circuit is common to many of the present crop of transmitters, AM as well as SSB, this solution may come in handy to you. A TV replacement power transformer was bridged for the high B voltage, and low B



Underside view of power supply section after modification. The 6DE4 sockets are top center. The bias transformer is dismounted from its right standoff to show the silicon rectifier strings.

voltage (one half the high) was taken from the secondary center tap. This is a common trick in transistor dc to dc converters, and took care of the high voltages. A separate half-wave 150 volt transformer was used for the bias.

The TV replacement unit used was the Merit P-2884, rated at 324-0-324 volts at 270 ma, with 5 volts and 12.6 volts center tapped at 5.6 amp windings. The mounting shell was not exactly suited for this mounting, but the new unit was the same size as the original, so the shells were swapped, which incidently

(Turn to page 88)

The Visitor

John Costos W2CRR

It was a normal weekday evening; the wife was busy with kitchen chores and the children were concerning themselves with homework or television, depending upon age. I had only given the evening paper a passing glance in preference to the February, 1963, issue of QST which had arrived that day. The W2AOE article on communications practice in the HF bands was especially interesting. In brief, W2AOE argued that a.m. should be made illegal starting January, 1964, the c.w. bands should be reduced by a sizeable factor and the phone bands should be increased with only s.s.b. operation being permitted. The QRM problem was becoming intolerable, argued W2AOE, and the only way to solve this problem was to conserve our precious spectrum space by reducing transmission bandwidths. Bandwidth-wasting schemes such as a.m. simply had to go and legal action would have to be used for the good of the majority. I had gone over this article for the second time and was rechecking the QRM arguments under the "Band Loading Capacities" and "Channel Loading" sections when it happened.

I don't quite know how to tell the rest of this story. I would like to forget the whole affair, but I can't because it has forced me to make a decision. What happened, you ask? I had a visitor. Not just a normal-type visitor but, as it turned out, this man who came to see me was none other than Larson E. Rapp! Worse yet, Rapp was not his normal, witty, amusing self. The Larson E. Rapp I had to contend with that night was a very angry and revenge-seeking Larson E. Rapp. As soon as we were alone in my study, Rapp wasted little time in telling me his troubles.

"The League has betrayed me," said Rapp with rising anger. "They have dumped me and are letting just anybody write my type of material."

"Come on now, Larson," I stammered, "Najork's 'Templeton Case' piece was pretty good, wasn't it?"

This turned out to be a poor job of mind-reading on my part as evidenced by Rapp's screaming response.

"Costas, don't try and humor me at a time like this! How stupid do you think I am? The 'Templeton Case' is not my type of stuff. You and I both know that there is nothing impossible about the general situation Najork described, even though the average amateur might consider this type of material as pure science fiction."

By this time Rapp was standing and had just begun to pace the floor when he whirled in my direction and shouted:

"It's the W2AOE article in the February issue I'm talking about. Haven't you read it?"

"Yes, I just finished it," I said, and added with some reproach, "and I don't see where this article has the slightest resemblance to your material. If this article is the cause of your complaint, then you're being very unfair to the League staff."

This apparently stunned Rapp, for he sat down, looked at me with some pity in his eyes and let me continue:

"W2AOE is pointing out that QRM levels are getting bad and the only way to meet the problem is by reducing transmission bandwidths. If this requires drastic action such as making a.m. illegal, then we should petition for such action. What's wrong with that?"

I was prepared to continue, but tears started to form in Larson's eyes. His whole attitude was changing from that of violent aggression to frustration and defeat. It took a few minutes for Rapp to compose himself, after which he spoke in a calm, even manner.

"John," he began, "what you just said only proves my point because, obviously, you too

have been taken in. That shows how cleverly written the article is. Not only are other people writing my stuff, but they are even doing a better job than I did. For example, who is complaining about a.m. operation on the phone bands?"

I took a minute to think this one over but before I could answer, Rapp continued:

"It's not the c.w. men because allocations prevent conflicts there, and the a.m. boys can hardly complain about a mode they are using themselves, right?"

"Sure," I answered, "it's probably the s.s.b. boys."

"How can it be?" countered Rapp, "We all know that s.s.b. has a 9db advantage over a.m., right? Now with this much power advantage it's the a.m. boys who should be screaming for help, not the other way around."

"Wait a minute, Larson, what about the spectrum waste due to the a.m. carriers? W2AOE makes a good case against that."

"How much spectrum space does a carrier occupy?" he asked with a trace of sarcasm.

"Anywhere from practically zero to a few cycles depending on the oscillator, the condition of the ionosphere, and the number of hops."

"Right!" Rapp hit back, "So we can easily notch carriers out at the receiver. Now if we ban a.m. and force all these guys to use s.s.b., the power they were putting into a few cycles which could be rejected at the receiver will now be spread over several kilocycles with no chance for getting rid of it. This will make the QRM problem worse, right?"

I must admit that Rapp now had me in a corner, but rather than show my temporary confusion I went on the offensive.

"Come on, Larson, what point are you trying to make?"

"Simply this," he shot back, "the true facts are that no one has any reason to complain about a.m. and, furthermore, conversion from s.s.b. back to a.m. would do much to reduce QRM. On top of all this, it turns out that it's the a.m. boys who have a case to present before the FCC because of the unfair 9db advantage of s.s.b. W2AOE makes everything come out backwards with a very logical presentation. If this isn't my type of material, what is?"

Rapp was now becoming more angry and I couldn't think of a good counterargument, so I tried changing the subject slightly.

"Look, Larson, maybe W2AOE did slip in a bit of sophisticated humor, but the rest of his presentation is certainly quite serious, espe-

cially those tables and the calculations showing the average number of signals in each channel for different operating modes."

That did it, Rapp really went on the attack now.

"John, I'm really beginning to wonder about you; didn't you catch the gimmick there?"

"No," I said with some confidence, "that part looked pretty sound to me. Furthermore, I went over this portion of the article with extra attention."

"OK," said Rapp (he was laughing now which made me feel a bit foolish), "you go over that material with me and I'll show you how you were taken."

"Well," I started, "W2AOE points out that the jumble of noises and chatter out of a receiver, tuned to a particular frequency, is due to a large number of signals falling in the passband of the receiver. Also, he points out that this random addition of many signals represents a QRM power level which can be measured by the receiver S-meter. OK so far, Larson?"

"Sure, sure that's fine, keep going."

"Then an estimate of the average QRM level is made by dividing the total number of stations on the air in the band by the number of channels in that band. In this way W2AOE obtains a number Q which represents the average number of signals per channel. The lower the Q number the higher the probability of a successful QSO because a better 'hole' in the QRM is likely to result. So the object is to use modulation techniques which give the largest number of channels and consequently the lowest Q values which seems——"

"Wait a minute," Rapp broke in, "you don't need to go any farther, you've already been hooked."

"How?"

"I'll tell you how," he barked, "W2AOE first discusses QRM as being caused by a level of interference *power* on the desired channel, then he neatly switches from power considerations to Q, the average number of signals per channel. The two are not the same. What he should do is multiply the average number of signals Q by the average power per received signal P to obtain an estimate of the QRM level. It is not Q, but the product Q times P that should be considered. Am I right?"

"Sure, that would be more nearly correct, but will it make any difference in the final conclusions?"

"It makes all the difference in the world." Rapp countered, "Just take W2AOE's example of all-s.s.b. operation on 20 meter phone. Estimate the average QRM power level to be expected in a given channel by using Q times P. Then work the whole problem over, but this time assume that all the s.s.b. exciters in use had a simultaneous malfunction so that, say, 10 s.s.b. signals were being generated and fed to the linears instead of the normal one."

"That's a screwy example, Larson," I said, "Do I assume that all these spurious s.s.b. signals fall randomly within the band? If so, the answer seems obvious. This will have the same effect as a ten-to-one increase in the number of stations on the band and the QRM per channel will be ten times as bad on the average."

"OK, wise guy, you go ahead and work it out while I go down and talk your wife into some coffee and dessert. Call me when you've got an answer."

As Rapp left the study, he smiled. It was not a pleasant smile, which bothered me but I was glad to be alone so I could collect my thoughts. I opened QST to page 54 and started to work.

Following W2AOE's channel loading arguments we may define:

Number of s.s.b. signals on the band=N
Number of s.s.b. channels available=C
Average number of signals on each channel=Q
Average power per signal as received=P
Average QRM power level per channel=I

Now the average QRM power level per channel will simply be equal to the average number of signals per channel times the average power per signal as received. Thus,

$$1 = Q \times P = \frac{N}{C} \times P$$

which is the same result obtained by W2AOE except for the multiplying factor P.

As I looked at the above equation it began to dawn on me that Rapp had hit upon something which is rather obvious after a little logical reasoning. If straight s.s.b. operation is first considered, certain values may be assigned to N, C and P and I may be calculated. The actual number values really aren't important. Now if all the s.s.b. exciters in use are assumed to have a simultaneous malfunction so that, say, K s.s.b. signals are generated instead of the normal one, then there will be K times as many signals on the band. However, the average power of *each* of these signals will be divided by this same factor K since each linear must now split the available power between the K signals now being amplified. This means that the average power per signal as received

will be divided by the factor K. Thus, for Rapp's rather wild example we have

$$I = \frac{(KN)}{C} \times \frac{(P)}{K} = \frac{N}{C} \times P$$

which leaves the average QRM power level per channel unchanged!

Stunned at the result, I quickly called Rapp, showed him my calculations, and was answered with,

"Sure, that's exactly what I came up with. You've done it right."

"But, Larson, look what this means." I pleaded, "If every station uses, say, ten times the normal s.s.b. bandwidth and the QRM power level on the average in each channel is left unchanged, what is the point to bandwidth conservation? In fact, the results seem to show that in the heavily-congested ham bands the average QRM power level in any given channel is determined, not by the bandwidth of each signal, but by the total power being poured into the band. The form of each signal or the type of modulation makes no difference, it's the total power being put into the band that is important. If this is so, then we've been spending a lot of money____"

A look of fear came over Rapp's face. He silenced me with a quick motion and got up to close the door. Sitting down, he pulled his chair close to mine and began talking in a near whisper.

"Look, John, you had better watch that kind of talk. What you say about the futility of bandwidth conservation for ham operation may be quite true. I've tried not to think about that aspect of my results because it's just too dangerous. I've stuck my neck out on a lot of subjects as my April QST efforts in years past prove, but I'm not about to get mixed up with this particular issue."

"But, Larson, we may have something here that is vital to the future of amateur radio. We may be wrong but at least we can study this and present our results to the ham fraternity for discussion and ____"

The fright in Rapp's face became more evident so I stopped. He continued, still whispering,

"You don't understand the situation, John. We're playing with dynamite on this one. Look, everyone agrees that the way to beat interference in the ham bands is to make more efficient usage of the available spectrum.

Everyone also agrees that the obvious way to do this is to convert to narrower-bandwidth transmissions. So we've had a big drive on to get everyone to shift over to s.s.b. Now this has cost the rank-and-file boys a lot of money; just look at the prices of s.s.b. gear these days. Do we dare even hint that this is not the answer? Furthermore, the whole thing has spread beyond ham radio. A lot of awards and honors have been given out by professional societies and a lot of big names have been built on the 'narrow-the-bandwidth-and-save-the-world' kick. No, John, pushing against this sort of thing is out of the question. Take my advice and just forget the whole thing."

Now I began to realize that Rapp was more than a good technical man and a clever writer. He was obviously an astute judge of people and political situations.

"Look," he continued, "we could be drawing the wrong conclusions from our work. The 'narrow-the-bandwidth' approach has never been challenged by anyone of any consequence. The boys at M.I.T., Stanford and other such respected places have gone right along, haven't they?"

"Yes," I said in resignation, "we could be wrong."

"No, we *are* wrong. Is that settled now, once and for all?"

I nodded in agreement and asked, "If narrower bandwidth is the answer, the W2AOE article in this regard is serious and then the League isn't exactly pushing you out of a job."

Rapp's mood now changed from fright back to anger as he said, "No, they are dumping me for sure. Don't you see, W2AOE gets the right answer by using the wrong approach. Remember that QRM argument where he switched from power considerations to average number of stations per channel? That was very clever. My gimmick was to use the right approach and arrive at a wrong answer. He does this too in the arguments against a.m., but he goes me one better in the QRM portion by getting the right answer in the wrong way. I don't mind so much being dropped by QST, maybe my stuff was wearing a little thin. But you would think that the boys at West Hartford would at least have given me a chance when they decided to start running my type of material again. But don't worry, I'll get even."

His last sentence was said coldly, without emotion. This man was surely bent on revenge and I wanted no part of any plot he might have cooked up against the League. So I tried changing the subject again.

"Larson," I started, "we have now agreed that going narrow-band on transmissions is obviously correct, but I hear a lot of grumbling these days on the phone bands. The boys are complaining that things are getting hopeless even with s.s.b. I heard one guy the other night making fun of those ads that show a ham pleasantly working the world from his fireside using a cute little 100 watt p.e.p. job, barefoot with a compact antenna."

"That's exactly it!" said Rapp excitedly, "After a guy goes into debt for two or three years to convert from a.m. to s.s.b., he expects results, not more of the same frustration. Sure this is becoming a problem and it's obvious that someone had better come up with a solution in a hurry. Now—and get this—I, Larson E. Rapp, ex-writer for QST, have the answer. I, not the League, will come to the rescue of ham radio."

I had put my foot right in it. It was no use trying to stop him, he was too excited.

"Look, our ham population is growing and we've got to reduce signal bandwidths to make more room for the newcomers, right? So what does the League push? They push s.s.b., that's what. All that cost and complexity compared to a.m. for a lousy two-to-one reduction in bandwidth. Peanuts! Too much investment for too little gain in spectrum usage. What I propose will offer a twenty—do you hear—a twenty-to-one reduction in phone signal bandwidth relative to a.m. The answer, my puzzled friend, is v.s.t., VOCODER SPEECH TRANSMISSION!"

Up to a point I thought Rapp was kidding, but his last sentence was certainly no joke. The Vocoder is a device developed by the Bell Telephone Laboratories. It takes the speech signal, analyzes it and puts out narrow-band control signals. These control signals, *not the speech signal itself*, are transmitted to another Vocoder unit at the receiving end which *recreates* the speech signal from the control signals. The bandwidth needed for transmission of the control signals is only about 300 cycles per second or one-twentieth of the bandwidth required for a.m. voice. Furthermore, the Vocoder is no new laboratory-type gadget; it really works. I've heard Vocoder speech which required only a 300 cycle channel and it is very good; you can hardly tell the difference between the Vocoder output and the original speech. So Rapp had done his homework and had come up with something that had to be taken seriously.

"Yes, John," Rapp went on with a no-nonsense tone in his voice, "s.s.b. has got to go and

give way to v.s.t. We can no longer tolerate the waste of our precious spectrum space by using a system that requires ten times the bandwidth of v.s.t. All right-thinking amateurs will convert voluntarily from s.s.b. to v.s.t. As for the rest, well, we will give them a reasonable time to make the change and after that we will petition the FCC to make s.s.b. phone illegal. One of these days we'll have to get on the ball and ask the FCC to give the s.s.b. boys one year to go v.s.t. or follow 'spark.' "

"How about the cost of v.s.t., Larson?" I asked as I pulled some paper out of my desk drawer and began to take notes. This was getting interesting.

"The cost will be more than for s.s.b., but consider what you are getting for your money. A ten-to-one reduction in bandwidth, and remember, bandwidth is the key. We can't buy bandwidth but we can buy the equipment which conserves the precious amount of spectrum space we do have. Besides, the cost to amateurs will be reduced because I'm forming a company to develop v.s.t. equipment for the military, but the same techniques will be applicable for the ham and commercial markets. In fact, I'll probably sell the ham v.s.t. line at a loss, at least at the start. So you see, with what amounts to a government subsidy, I can materially reduce the cost of v.s.t. for the amateurs."

"But, why sell to the amateurs at a loss? Is this an act of philanthropy on your part?"

"Hardly, it's really a two-pronged marketing attack. You convince the amateurs that v.s.t. is good because you can show them that the military is spending millions on the system. At the same time you can point out to the military that the amateurs are using the system so that not only is v.s.t. effective, but it can be operated and maintained in the field without trouble."

"How effective will v.s.t. be in operation as compared to s.s.b.?"

"All I can say here is that v.s.t. receivers need only one-tenth the bandwidth of s.s.b. receivers so that the input noise or interference power is reduced by a factor of ten."

"Are you saying that v.s.t. has a ten db power gain over s.s.b.?"

"It sure looks that way, but I'm not going to make any flat statement in that regard. However, once the bandwagon starts rolling there will be plenty of people who will show that this is the case."

"Larson, I go along with amateur promotion of v.s.t. because we just might profit from the tremendous bandwidth saving being offered. However, shouldn't you go a little easy on the military end?"

"What do you mean by that?" asked Rapp with obvious annoyance.

"Well," I said, "what would happen in combat if an enemy s.s.b. station were working on top of one of our v.s.t. channels?"

"The v.s.t. channel would probably be in real trouble, but the s.s.b. circuit could go right on by simply notching out the much narrower v.s.t band of frequencies."

"Wait a minute, Larson, you're now killing yourself in the military market. How can any branch of the service dare use v.s.t. if it won't stand up to s.s.b. under combat conditions?"

"John, I'm not going to make any claims as to the combat-worthiness of v.s.t., it may perform poorly under such conditions."

"Then how do you crack the military market?" I asked.

"By simply telling them the simple truth. With v.s.t. they get ten voice channels where they now have one with s.s.b. That will sell it, don't worry."

"But what if they test v.s.t. under simulated combat conditions against s.s.b. interference and your system falls on its face. Then what?"

"That's easy; this just proves that s.s.b. causes unnecessary interference and gives added emphasis to the need for eliminating such interference by accelerating the conversion from s.s.b. to v.s.t. Don't forget, by this time the more progressive hams who have converted to v.s.t. will also be yelling for the removal of s.s.b. signals from the amateur bands. So my job will just require sitting back and letting nature take its course. Remember, I wasn't being sentimental when I planned on selling the v.s.t. ham line below cost. You've just got to think ahead to stay ahead in business, my boy."

"Look, Larson, these military people for the most part are dedicated and public-spirited individuals. National defense has gotten pretty scientific these days and specialists like you and me can easily put one over on a guy who has so many other things to worry about that he rarely finds time to keep up to date technically. Remember, we work at our specialty 8 to 12 hours per day. Don't we have an obligation to our country and the military to try and steer them in what we think is the right direction? I know it sounds corny, but doesn't patriotism enter into the picture at all?"

This brought on an embarrassing silence, so I had no choice but to pick up the conversation again.

"Larson, the research centers and univer-

sities will look into v.s.t., how will you make out there?"

"Great, John, just great. The scientific community will eat this v.s.t. stuff right up. They liked s.s.b. because it was fairly complicated, but about the only high-powered math you could apply to s.s.b. was Hilbert Transform Theory and, of course, the usual Theory of Stochastic Processes. But with v.s.t., it's a whole new world! Just think of the way a Vocoder works! You've got Man-machine Relationships, Dynamic Programming, Bionics, Self-Optimising System Theory, and probably a few new ones when government-sponsored v.s.t. research really gets rolling. Yes, the scientific community will be one of the biggest boosters of v.s.t., that's for sure."

By now I was convinced that Rapp and his v.s.t. scheme were going places.

"Larson, I'm sold. When do you plan to start active promotion of v.s.t.?"

"Just as soon as the sunspot cycle goes on the rise again, naturally."

I didn't quite understand this answer but rather than reveal my ignorance, I nodded in agreement.

At this point Rapp cut off any further questions and made me a business proposition. I won't go into the details because this would violate business ethics. I can tell you that Rapp has lined up some impressive financial backing on Wall Street and he has a Madison Avenue advertising firm already at work on the promotional aspects. He offered me a chance to go in with him and left me a contract to sign. My share appears to be relatively small but there are some stock-option and trust fund provisions that have definite capital gains and other tax advantages. He told me that the contract had to be signed within 60 days and then left.

By now it was well past midnight and the family had long since gone to bed. I couldn't sleep; Rapp had given me far too much to think about. I went downstairs, poured a drink and sat at the kitchen table to try and clear things up in my mind.

How much of what Rapp had said was correct and how much was wrong? Also, if some of his statements were in error, was this accidental or was he purposely trying to mislead me? Many of the arguments advanced by Rapp appear to contradict points of view that most of us have long accepted as being obviously correct. Yet when one gives some of Rapp's arguments some thought, it becomes difficult to reject what he says. Especially bothersome is this whole question of whether

bandwidth conservation is really important or even helpful when heavy congestion is encountered. Rapp knew more than he was telling here, that was obvious. Our calculations seemed to indicate that the QRM power level per unit bandwidth, on the average, is not affected by the bandwidth of the transmissions. Yet narrow bandwidths are desirable as c.w. has proven for years. But then there may be something wrong with comparing phone and c.w. since the information or word-per-minute rates are drastically different. *Could it be that the information rate is the fundamental quantity and not the bandwidth?* If we got phone bandwidths down to a few hundred cycles, this should reduce QRM because of the very narrow passband needed for reception. But would the phone system now be so much more sensitive to interference that we would still be back where we started? No, Rapp is right, it is best not to pursue this line of reasoning. After all, if there were something fundamentally wrong with bandwidth conservation for amateur and military usage, the boys at Rand or M.I.T. or someplace like that would have caught it by now.

So now I'm convinced bandwidth conservation is important and has a bright future. What about Rapp's v.s.t. scheme? I know enough about the Vocoder to realize that the system really works. Furthermore, it was developed at Bell Laboratories and that's also where s.s.b. originated. But if we push v.s.t. and it goes over big, this could result in the outlawing of s.s.b. on the ham bands. This might be hard on some of the boys, but after all, one has to be willing to pay a price for progress——— I guess.

All of this still leaves me with a decision ———the contract Rapp left expires in 60 days. What do I do?

. . . W2CRR

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73 Reviews

The Paco Model G-15W Grid Dip Meter

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% KBIM, Box 910
Roswell, New Mexico

The grid-dip meter is a most useful accessory around the ham shack. Instrument manufacturers have obviously recognized this to be a fact, for the latest issue of Electronics Buyers' Guide shows 15 companies fabricating the little gems.

This is not the place to explain what a dipper can do. For the curious we seriously recommend a quick check with your favorite handbook. For the better informed we here present data on the PACO Grid-Dip Meter.

Condensed Specifications

Frequency range: 400 kc to 250 mc.
Functions: Grid dip meter, absorption wavemeter, modulation indicator, and other uses related to these three basic functions.
Size: 7½ inches long, 2¾ inches wide, 2½ inches deep. One-handed operation.
Power: 115 volts, 60 cycles, approximately 10 watts.
Shipping weight: 3 pounds.

Grossly . . . .

Condensed specifications are shown in the accompanying table. This will show the unit to be more or less typical of units in this price range. How does the device differ from the competition?

Removing the little gem from its packing (very well packed, by the way), I immediately found myself holding it just like the pictures shown. The size is such that it fits into one's hand very naturally and easily. It has a heavy feel—I was under a first impression of a steel case. It's actually of fairly heavy aluminum, with a pretty hefty coat of grey paint.

For clarity, the various scales are printed in alternate bands of black and red. These are clearly indicated by alphabetical letter. The corresponding coils are color-coded in a manner similar to the resistor code: the first coil

is brown, the second red, third is orange, etc. So, going on the assumption that you know the color code, grabbing for the proper coil is child simple.

Functions

The device works well. The well-written instruction manual shows 15 different things that this little machine will do. One of them is to give an indication of modulation percentage. This is unique with PACO, and is obtained simply by altering the grid circuit configuration. It is particularly suited for telling the ham exactly what he wants to know: if he is at or near 100% modulation.

A phone jack is included so that the unit can be used as either an oscillating detector or for audibly monitoring phone transmissions.

The usual diode/dipper switch is included. This unit seems to have higher than average sensitivity in the diode position. Specifically, a two meter rig with a pair of 2E26s in the final gave a quarter-scale deflection of the meter at a distance of about 6 inches. I suspect this is due to the half-mil movement and the lower than average value of grid resistor, 10K ohms.

Another unique thing, or at the very least unusual, is the inclusion of a serial number on the unit. Especially among the smaller kits this is probably a worthy innovation.

On the subject of physical examination, it might be worthwhile to point out that the internal appearance is neat. But one must remember that the oscillator section of any grid-dip meter is invariably set up for *very* short leads in order that the thing will function well on the higher bands.

The instruction book seems to cover every conceivable point. Uses, trouble shooting, maintenance, guarantee (very reasonable terms, 90 days) and parts list are included. 13 pages cover 15 suggested uses, with the understatement that "other uses will become apparent." A chart included so that unknown capacities from 50 mmfd to .007 mfd can be measured.

Comments

There is a minor set of small false dips on the highest range, but these are, first, insignificant, and second, typical of every dipper I have seen.

The meter zero adjustment is a bit sensitive, but this is a result of designing the unit so that in effect the scale is expanded. As a result, the dips are quite pronounced and obvious. The byproduct is a seemingly overly-sensitive zero adjustment.

One-handed operation is not only feasible, but practical.

Frequency accuracy is within a few percent on each of the 4 ranges checked.

We had the gadget about a month or so and finally managed to drop it. As luck would have it, it landed on the coil—on a cement floor. Now the PACO might be rugged, but not *that* rugged! A new coil was ordered, and less than a week later we had it. Quite a change compared to some manufacturers, and most comforting to know that the company stands behind you. . . . W5SUC

a technical discussion

The Cubical Quad

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The cubical quad is a natural development of the folded dipole. Observe Fig. 1. This is a folded dipole. The input impedance is approximately 300 ohms. Now stretch the sides of the folded dipole out so the included angles formed are 90 degrees. Fig. 2. This is now a quad, and the input impedance is approximately 125 ohms. Continue to stretch the sides out and we finally have a shorted half wave line, with an input impedance of approximately zero ohms at resonance. Fig. 3.

We are interested in the quad wire, stretched only half way out, so that a square is formed. As noted above, the input impedance of this configuration is approximately 125 ohms. Now add a reflector ⅛ wavelength (about 8 feet) behind the radiator portion, and the input impedance drops to approximately 75 ohms, a good match for RG11U co-ax.

The power gain of the radiator portion of the quad only approximates 1 db over a dipole. The power gain of a quad with a reflector approximates 7-8 db over a simple dipole. With a properly adjusted reflector stub, or coil, the F/B ratio approximates 25 db. The F/S ratio is even higher.

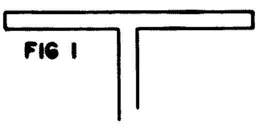


FIG 1

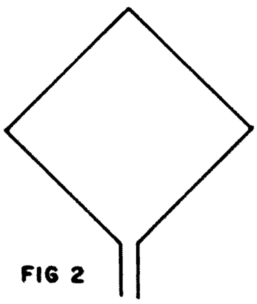


FIG 2

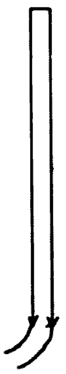


FIG 3

L.T.

The Q of a cubical quad is low. The Q is the ratio of the reactance of an antenna to it's radiation resistance. The advantage of a low Q antenna is that it is less frequency selective, and therefore easier to feed. If the SWR of a quad is, or approaches 1:1 at resonance in the middle of an amateur band, then the SWR rises very slowly as the transmitter is tuned towards the ends of a band. This is a distinct advantage.

It must be understood that the figures mentioned above concerning F/B ratios and gain figures, may vary considerably from those mentioned, due to local conditions. They may be greater or less. The height above an effective ground, the presence of nearby objects, etc., all affect these figures, either for better or for worse.

The half power point of a quad is approximately 75 degrees. It is truly a broad band beam. Of course, the F/B ratio will vary as the quad is tuned away from resonance, but it varies rather slowly, and may be considered as good at any place in the amateur band, if the quad is resonated at the center of the band.

The total length of wire for a 20 meter quad should be 844" for the 15 meter quad 575 inches, and for the ten meter quad 414 inches.

These figures change somewhat when a quad is built for three bands on a single framework, as shown in the diagram, Fig. 4. In general, the sides of the quad for 20 and 10 should be modified somewhat, and made somewhat less, due to the fact that the 10 and 20 quad wires are pulled in to the feed point of the 15 quad. This reduction, in the case of the 20 meter quad is about 4 inches per side less and in the case of the 10 meter quad, the reduction in length is approximately 2 inches. If this is not done, the bands in question will resonate somewhat lower in frequency. This will not materially effect the operation, however, and may be ignored in the practical case.

14.0-40 ohms	14.2 -70	14.4 -80
21.0-50 ohms	21.22-50	21.35-50
28.0-50 ohms	29.0 -50	30.0 -80

Fig. 5

The quad is particularly suited to multiband construction, as shown in Fig. 4. A single framework will hold all three quads very nicely. In fact, the three band model is more rigid than a single quad. There is no noticeable reaction between quads when the multiband quad is used.

A single feed line may be used to feed all three quads, and no switchover system is needed or desired. The input impedance, as measured on a three band single feed line system, is as shown in Fig. 5. This indicated that the feed line may be either RG8U or RG11U. Use 8U if xmtr output x req. The SWR on the three bands has been measured as indicated in Fig. 6.

A quad may also be constructed for 40 meters, but the size is such that it first must be determined whether or not there is room for erection. The length of a side would be approximately 35 feet and the boom length would be 16 feet.

The reflector portion of a quad must resonate at approximately 5% lower than the radiator. This may be accomplished by the use of either a tuning stub, or a reflector coil. The reflector coil is compact, and needs no arrangement for holding the ends. A stub is somewhat easier to tune correctly, but is more cumbersome, and needs an arrangement for holding the stub in place. A stub arrangement is a likely arrangement for a single quad, but the coils are much superior for a three band quad, due to the complicated lash up necessary where three stubs are used. A reflector coil may consist of several turns of wire wound on a one inch diameter, non-hygroscopic tube. The same wire as used for the quad elements may be used for the coils. No. 14, enamelled copper wire is recommended, as it will carry a full kilowatt with ease.

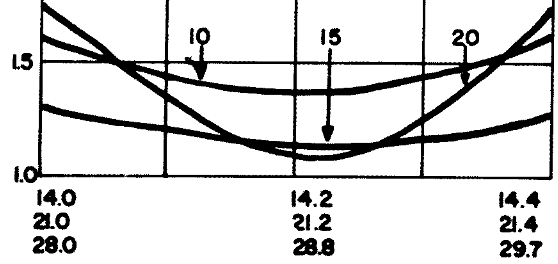


FIGURE 6

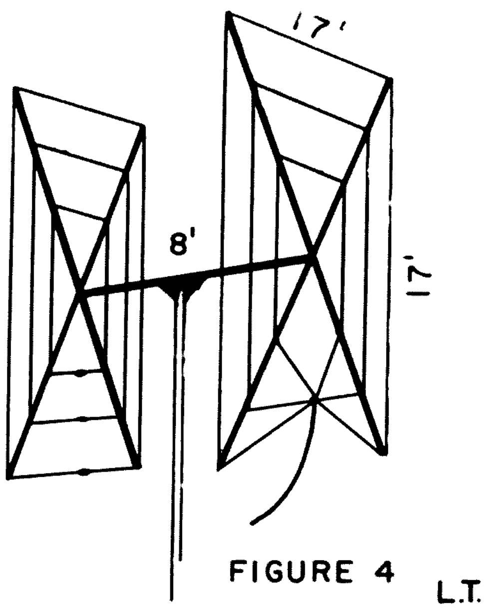
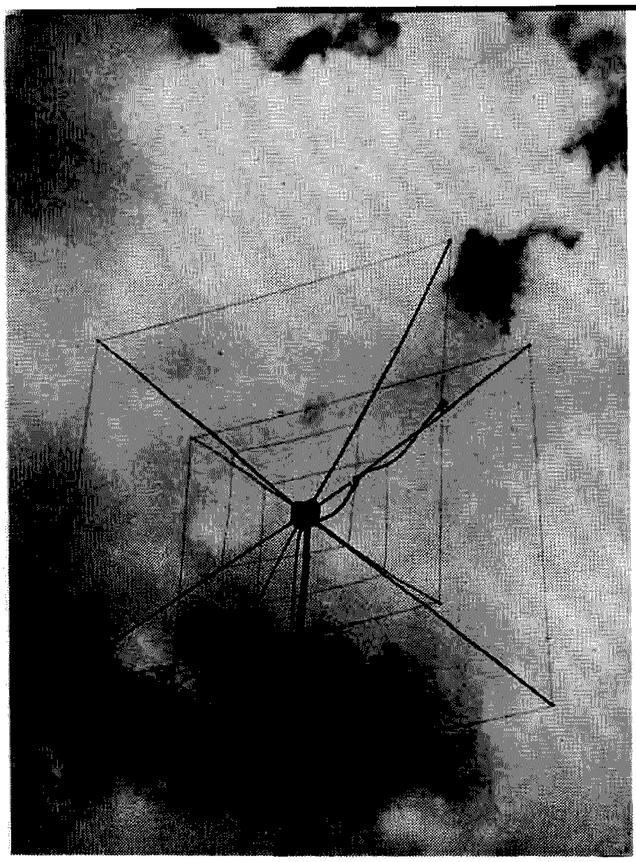


FIGURE 4

Quad spreaders may be either of bamboo or fiberglass. The bamboo spreader will last for several years if properly treated with several coats of alkyd resin enamel. Another way to treat bamboo is to spiral wrap it with plastic tape, wrapping from the small end. It is well to dab the bolts which hold the quad wires with a bit of roofing cement to prevent entry of water in this case.

Fiberglass spreaders are of course, ideal for spreader arms. They deteriorate but little from the weather. They are even lighter than the bamboo, and are extremely resistant to lateral stresses, although they can be crushed by dropping a heavy weight on them. Of course, they are absolutely straight, while bamboo is not. They are more expensive, of course. They need no treatment against the weather whatsoever. Bamboo should be bought in 20 foot lengths, and cut to the 12½ feet necessary for the spreader arms, in order to have a reasonably large tip at the outer end. Curved washers should be used to fasten the bamboo or fiberglass to the end spider, and they should also be used in either the bamboo or fiberglass where the quad wires cross. This distributes the pressure of the bolts over a greater area than if flat washers were used.

A quad is truly an outstanding performer on the amateur bands. It possesses all the desirable qualities of a good beam, namely, reasonably low cost, good gain, good F/B ratio, and low Q tuning characteristics. It is an easy beam to feed, and seldom, if properly made and adjusted, exhibits appreciable reactance at the load. Check the signals, on the air, of amateurs using cubical quads. They are almost invariably outstanding. . . . W4YM



A Two Band VHF Quad

Joe Williams W6SFM
4150 Beck Avenue
North Hollywood, Calif.

Photo credit: Bob Jensen W6VGO

The Quad is no longer a "new" antenna but it is showing every sign of never becoming an old antenna. The unique structure and performance of these beams has made them a subject and the objects of continuing interest to radio amateurs. In short, the quad seems to be here to stay. The first cubical quad was devised by W9LZX while he was associated with missionary radio station HCJB near Quito, Equador. That first quad was cut for an International Short Wave band and was beamed on the United States; later W9LZX, using the call HC1JB, used a quad on the 20 Meter ham band. The rest is a part of amateur radio history. The quad caught on and has snowballed to become one of the most popular DX antennas in the world.[1] The simplicity and efficiency of this antenna type makes it an excellent array for the high frequencies and it is finding increased favor as a VHF radiator and collector.[2]

A most casual survey of antennas for HF and VHF will reveal those qualities that are sought by the amateur who intends to build his own beam. An antenna that is attractive is one that will render reasonably consistent results and which can be constructed and used with a minimum of folderol. The Quad is such an array. In its simplest form, a quad is a one wavelength driven loop with an adjacent parasitic reflector. The reflector is spaced from one-tenth to one-quarter of a wavelength behind the tuned square and caused to be self resonant at a frequency about 5% lower than that of the Antenna element. This combination will produce a two element beam that is capable of a 5 db forward gain, a front-to-back ratio of 15 or more decibels and a low radiation angle.

In any antenna system, the optimum adjustment of the antenna in regard to forward gain, front-to-back ratio, drive point resistance and VSWR will be obtained at one specific frequency and only at that frequency. When an array is worked at other than its design frequency, compromises of the above characteristics will occur. The ability of an antenna to be operated at any distance from its design point depends upon its type. The Rhombic is perhaps the most tolerant of antennas since it can be operated over a 2 to 1 frequency range. A

quad will perform very well from 3% below its design frequency to 5% above that frequency and it is for this reason that quad frequency placement is often toward the low end of the amateur band for which it is cut.

The light weight VHF quad shown in the photographs and diagrams was designed to provide a simple two band beam that would offer a reasonable measure of gain, an effective degree of directivity and economy of construction. The true "cubical" quad has a spacing between the driven element and the reflector of one-quarter wavelength; this gives the array a cuboid outline. As a practical matter, the cubical quad is more difficult to build and will render less forward gain than some other quad forms. Field tests have indicated that the element spacing that will give the highest gain—5.7 db—is one-eighth wavelength.[1] $\lambda/8$ pacing can be developed without a boom and is the spacing used in this VHF quad. The plywood spreader support used in its construction causes the relative spacing of each antenna in this array to be the same. In a free-space situation where a quad's environment is perfect and its reflector is properly tuned, the amount of space between the driven element and its reflector is the principal drive point resistance determinant. This means that under certain conditions one transmission line can be caused to match, or nearly match, either of several driven elements.[3] This is possible just as it is possible to work more than one dipole from a single feedline when the dipoles are suspended at a proper height above the ground.[4] Ordinarily, we could expect the $\lambda/8$ spacing between the elements of this VHF quad to create a radiation resistance of about 60 ohms. This impedance figure presupposes that the ground is moderately conductive and that foreign objects such as trees, power lines, the mast, guy lines and other quad elements exert no influence over the behavior of the quad. Such a model situation seldom, if ever, exists and for that reason the feed point impedance of each driven element is considered to be in the neighborhood of 52 ohms.

Construction

The construction of this quad begins with the spreader support block. Two identical plywood plates (Fig. 1) are glued together with Weldwood cement to make one strong unit. The dimensions of each plate can be drawn on the ¾" plywood stock to facilitate the sawing. Any kind of fine toothed saw can be used to make these cuts but a tilt-head sabre saw or a table saw will make this work fast and easy. The tongue of wood that remains after the slot cuts have been made can be removed by scoring and delaminating with a wood chisel or a sharp screwdriver. Square blocks are not used to make the spreader support because they will not produce the desired aspect ratio when the plates are assembled. The corners are trimmed to make flat surfaces for the drilling of the spreader socket holes. These holes, which should be made after the spreader diameters are known, should be piloted with a small drill prior to the final boring. Slight drilling errors at this stage of the construction will be magnified into larger errors when the spreaders are mounted—so much care and enough time should be spent here. In the building of the prototype of this quad, the holes were made with an electric hand drill and a small liquid level was used to make sure that the drill was perpendicular to the work. After the plywood block is completed and the cement has set, the holes for the U-bolt mast clamp can be drilled. The U-bolt can have a throat size of 1¼ to 1¾ inches and must be at least 3¼ inches long. The "V" saddle formed by the joined plywood plates serves as the other half of the mast clamp as shown in Fig. 2.

The spreaders used in this quad are made of bamboo. These particular bamboos are 4 foot plant stakes which are standard nursery items

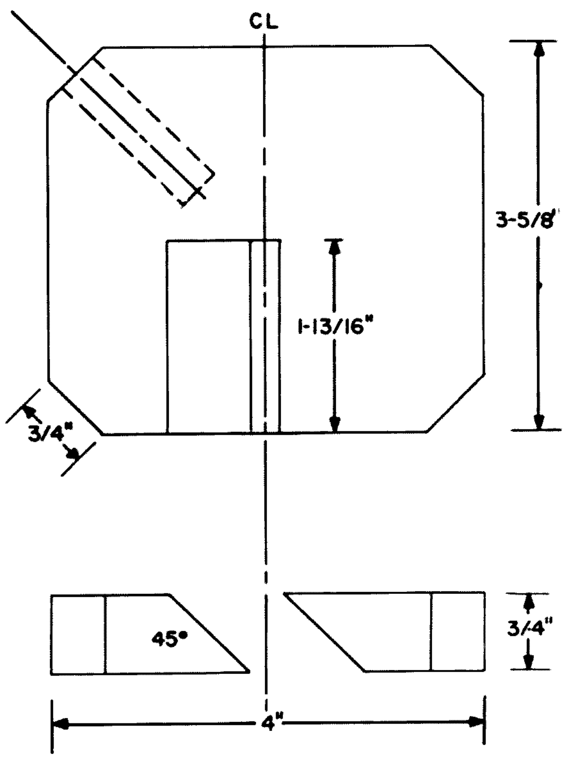


FIGURE I

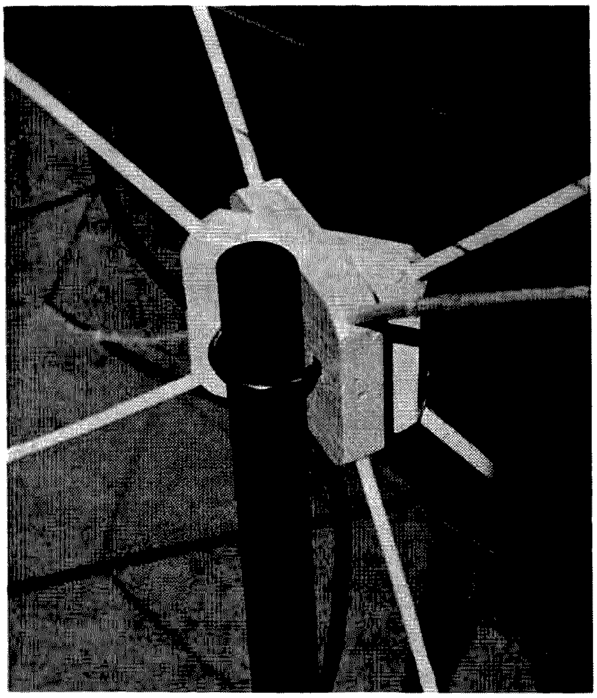


Fig. 2

priced at about a nickel each. They should be selected so that they are straight and have base end diameters of about ⅜". Dowel stock of ¼" to ½" can also be used. A four foot length of ⅜" dowel is sometimes hard to find but 8 foot lengths of 7/16" stock are reasonably common at lumber yards. The use of dowel spreaders will increase the weight of the quad. The spreaders are cemented into their sockets but should not be trimmed until the quad has been completed. After the cement has set, the block and spreaders can be weatherproofed and the builder has several choices of materials for finishing the wood parts. Varnish, Epoxy paint or boat resin will all provide protection and, if it is necessary, ordinary house paint can be used. The quad in the photos was plasticized with a west coast product called Varathane.

In figuring the wire tie points on the spreaders, all measurements are made from the center of the support block. As the measurements are made, marks should be placed on the spreaders at 15" and at 43½" for the driven elements. For the reflector spreaders, the marks should be made at 15¾" and at 45½" unless stub tuning is to be used. If stubs are used, as described later, mark the reflector spreaders just as the others.

The Wires

The builder can use the wire dimensions given here (Fig. 3) or the elements can be cut to favor local net or repeater frequencies. The inch is handy for VHF use and will lead to less annoyance than will the use of feet and decimal fractions of the foot; to compute the length, in inches, of each side of a driven element: the design frequency, in megacycles, is divided into the constant 2976. The reflectors of this beam are stubless and their dimensions are based upon dead reckoning. That is, each reflector is made 5% longer than its associated antenna element. This method of reflector construction was chosen for the following reasons. An oversized reflector can be made up, installed and used with no instrumentation; the absence of a stub will avoid any distortion of the radiation and collection patterns that sometimes occurs with stub use; the oversized reflector will increase the *effective aperture* of each quad section and will enlarge the capture area of each of the antennas. Stubs can, of course, be used to artificially lengthen the reflectors and their use in quad construction is common. When stubs are used they should be in the form of 3" open wire ladders which are closed at their bottom ends. The stubs can be insulated and separated with three-inch plastic spreaders or the old stand-by: dowels which have been boiled in wax or paraffin. The stubs are inserted into the centers of the bottoms of the reflector wires.

Using solid or stranded wire of #16 to #20 gauge, the antenna and reflector squares should be carefully planned. After being freed of kinks and having been stretched slightly, the wires can be measured and marked off with nail polish. The wire marks should be made at those points that will become corners when the loops are attached to the spreaders. Each

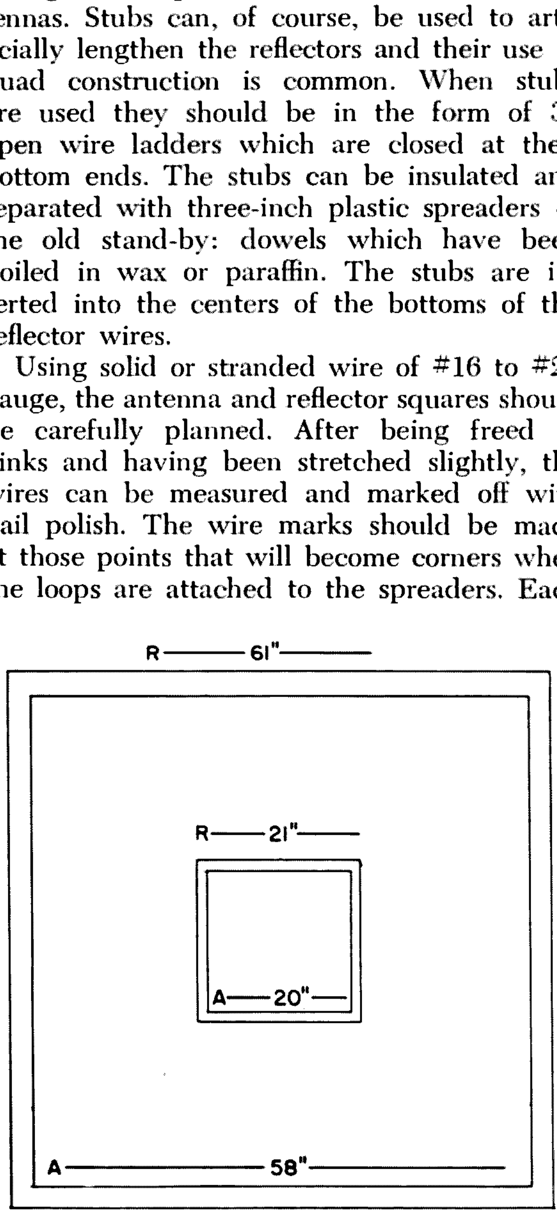


FIGURE 3

wire element is attached to the spreaders with 15 pound test soft monofilament fishing line. A series of clove hitches and square knots can be used to secure each wire corner to its proper spot on the spreader. It's easier and neater when the monofil is tied to the spreader first. After the monofil is trimmed, the ends can be burred with a hot cigarette to prevent unraveling. The insulators used at the feed points of the driven elements should be small and light. 1" slugs of plastic, drilled to accept the wires, will work fine and a toothbrush handle will furnish enough insulators for the whole project. The drive points can be waterproofed by enclosing them in small plastic boxes as shown in Fig. 4; the boxes can be sealed with model cement.

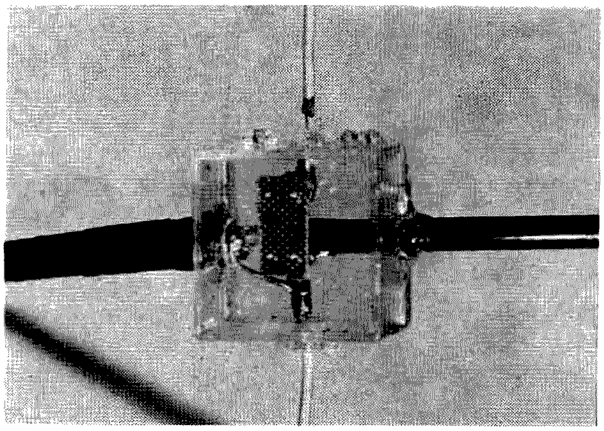


Fig. 4

This quad is light and is not very big but it will be found that element attachment goes easier if the block and spreaders are supported while this work is being done. If the block is clamped to a section of mast and the mast is held horizontally in a bench vise, it will be possible to walk around the spreaders to make the wire ties without too much difficulty. The 2 Meter elements should be attached first. Another way is to position the quad frame on the seat of a kitchen chair so that the ends of the spreaders will be free for work. When the 6 Meter wires are tied to the spreaders, it is possible that the marks on the wires will miss the marks on the spreaders by as much as an inch. This can happen due to small sawing or drilling errors or because one or more of the spreaders is slightly crooked. Such small errors won't affect the performance of the array. After all of the wire elements have been attached, a 30" monofil stay should be tied between the spreaders—from the front to the back—at each 6 Meter corner. The monofil stays will add no appreciable weight and will true up the quad frame geometry and stabilize

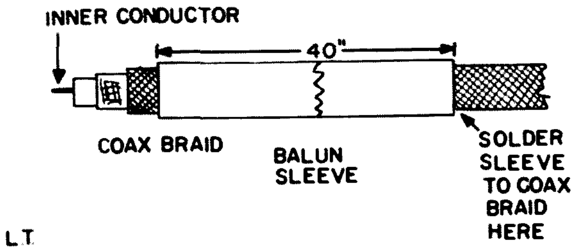


Fig. 5

the antenna mechanically.

The Feedline

We are all familiar with the classic transductance equation in which the generator, the line and the load all possess the same characteristic impedance and in which there are no balanced-to-unbalanced problems. Under such an arrangement, the only losses that are incurred are the natural losses imposed by the rf resistance of the feedline. Unfortunately, this ideal situation is rarely enjoyed by the radio amateur. Feeding quads is like feeding other antennas in that it is sometimes necessary that we use devices or tricks in order to get the rf energy to and from the quad's feed points with a minimum of loss. The quad is a balanced antenna and should be treated as such; this means that the most elementary form of transmission line that may be used with the antenna is a two conductor balanced affair such as open wire or twin-lead. For the sake of convenience, however, coaxial cable is more often used. The use of coax at the transmitter end is simplicity itself since it is usual but necessary that the cable be connected to the pi-net matching circuit, or the output link, of the rig. But when coax is used, two bugbears present themselves: it becomes necessary that some form of balun be employed to satisfy the balanced quad; and coaxial line losses are high—particularly at VHF.[5] Practical solutions to these problems exist and they will be partially catalogued here. The builder has the choice of several functional feed methods and it will be assumed that the quad will be used with an unbalanced shack termination in both the transmitter and the receiver.

The simplest and roughest way to feed a quad with coax is to cause the antenna to display a radiation resistance at each of its driven elements that will approximately match the impedance of the coax and then just solder the braid and inner conductor to the driven wires where they are brought together at a common insulator. This drive method ignores the fact that the quad is a balanced array—but it works. In fact, it works better than it has a right to. Many quads are fed this way at the High Frequencies and they turn in creditable performances. The drawbacks to this arrangement include: feedline radiation, deceptive SWR readings and a directive skew in the radiation pattern. Where such a feed method is used, feedline radiation can be reduced by the use of a coaxial "balun." This is an electrical quarter wave of coax formed into a king sized doughnut and bound with tape. This type of "balun," which is really more of an rf choke, is situated near the driven element feed point. The extra loss introduced by this device is not attractive at VHF and it is not particularly recommended.

The Gamma match is an excellent system for meeting both the impedance matching and the unbalanced-to-balanced problems that go with quad feeding. This tuned transformer is described in detail in the ARRL *Handbooks* and in the W6SAI book, *All About Cubical Quads*. The most satisfactory single-line feed method for the multiband quad revolves about the use of the Gamma match and it will produce the lowest true voltage standing wave ratio that can be obtained. The Gamma matching procedure is, however, lengthy and complex and requires some things not found at every hamshack; a crank-up tower, good instrumentation, waterproof variable capacitors and much time and patience.

The Sleeve Balum,[1, 6] which is recommended for this 6 and 2 quad, is handy as a transmission line modifying device. (Fig. 5). Sometimes called the "Bazooka," this type of balun will change a coax from an unbalanced cable into a balanced line without transforming the impedance greatly as does the "Trombone" balun. To feed a quad with a sleeve baluned single coax is possible if the quad is for one band or if it is built for two bands having a 3 to 1 wavelength relationship. 40 and 15 meters for example. This is feasible because $\lambda/4$ on 40 is ¾ of a wavelength on 15; thus sustaining the "odd number of $\lambda/4$" requirement of the sleeve balun's electrical dimensions. The same concept allows the practical, if not exact, use of a 6 meter sleeve at both 6 and 2 meters. The balum sleeve is the same length, 40", whether it is made with RG 8 U or RG 58 A/U because each cable has a velocity factor

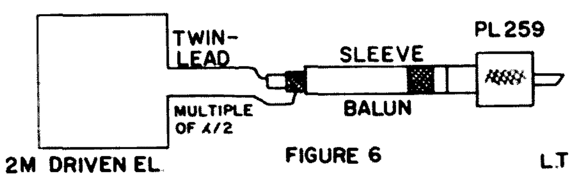


FIGURE 6

of dot sixty-seven (.67) and an electrical quarter-wave is 67% of a yardstick quarter-wave. The sleeve can be made of woven braid of the type often used for flexible bonding straps. Getting a Meter of braid to slip on a coaxial cable can be quite a tussle and it's easier if the braid is put on in several short lengths and joined with solder after the sleeve is completed. At the builder's option, the sleeve can be made by winding bare copper wire upon the coax in the manner of a long coil. The sleeve bottom is soldered to the coax braid and should then be waterproofed with pre-warmed plastic insulating tape. If the quad is built for 2 Meters only, make the balun sleeve 13½" long. When coax is used entirely, the sleeve is installed at the load end of the line; but if the line run exceeds 60 or 70 feet the coaxial losses will become high, especially at 144 mc.

An inexpensive and more efficient line can be made of open wire or twin-lead. In this arrangement, the balun is made up and used at the shack end of the system as indicated in Fig. 6. The balanced output of the coax is connected to the open wire as shown. The common types of twin-lead or open wire obviously will not impedance-match either the quad or the balun; so the line must be cut to a multiple of an electrical half-wave.[7] The velocity factor of household twin-lead is .82 and a 300 ohm line can be any multiple of 95". Typical lengths might be 47' 6" or 63' 4". Clearly, the tuned line will not be right on the nose for each band, so the following procedure is suggested: make the twin-lead line 8 inches longer than its computed length and check the SWR on each band as the balun connection point is tapped back toward the computed "mark." This way, the feedline can be trimmed to a spot that will be compatible with each of the driven elements. Open wire lines are affected by environment and should be transposed—by twisting—to cancel the effects of nearby conductive objects. Twin-lead can be treated with silicone compound so that moisture will not cling to upset the qualities of the line.

It is also possible to feed the antennas by using open wire and a pair of "Trombone" baluns.[8] This method requires a balun at both the sending and the load ends of the line. The use of a multiple $\lambda/2$ wire line and balun combination can cause the drive point impedance to be mirrored to the transmitter and good transconductance will be obtained.

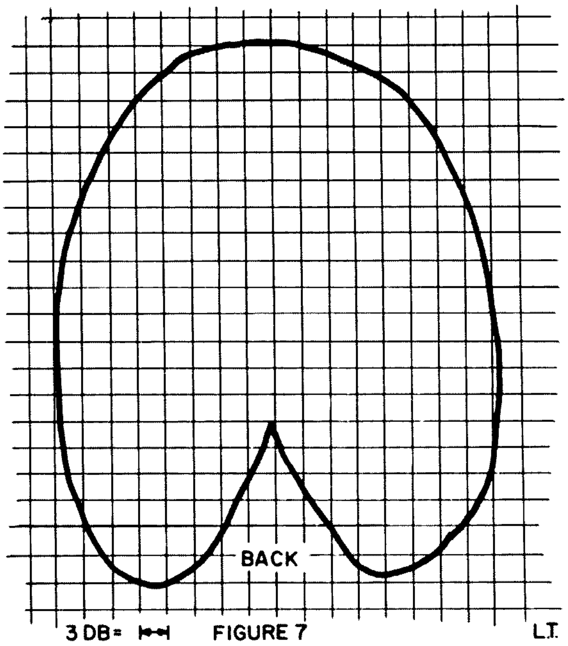


FIGURE 7

Feedline Connection

The balance corrected load end of the feedline is soldered to the 2 Meter driven element. A 20" length of coax is connected from the 2 Meter drive point to the 6 Meter driven wire. It may seem strange to use an unbalanced coax for this link but if open wire were used here, the 6 Meter driven element would see the open wire link as an extension of itself. This would cause the antenna to be self resonant considerably below its design frequency. The coax link is less than $\lambda/4$ at six meters and thus does not assert its character and becomes two pieces of wire—one inside the other.

SWR

The most familiar indicator of the feedline to antenna impedance match is the old boomerang factor—SWR. If a quad is operated with an SWR in excess of 2:1, two things will occur; the directivity will get soft and line losses will be higher. A high SWR will create an rf loss factor that increases as the line is lengthened. In a very long line, the standing wave ratio can be deceptively low because of the line loss presented to the returning reflected signal by the long line.[9] The design frequency SWR's of this quad were checked as the quad was being fed with a line and balun made of 30 feet of RG58 A/U. The signal sources were a modified Collins MBF and a Gonset Communicator II. Readings of 1.25:1 and 1.65:1 were obtained at 6 and 2 meters, respectively, on a Heath Kit AM 2 reflectometer which was strapped for 50 ohms.

Adjustment

This quad has been built for vertical polarization because it is very popular in the Los Angeles area. If horizontal polarization is desired, feed the driven elements in the centers of their bottoms instead of their sides. If the antennas are fed at a corner, oblique polarization will result.

If the quad is built with the pre-cut oversized reflectors, adjustment is not intended. It should be realized, though, that the optimum front-to-back ratio and forward gain relationships may not occur precisely at the design frequencies. When 3" wide stubs are used, they should have initial lengths of 9" for Six and 3" for Two Meters. The stubs can be experimentally shortened, if F/B improvement is sought, by shortening the stub with a shorting bar made with a crocodile clip at each of its ends. Such tests are more easily conducted with the receiver tuned to a properly polarized carrier which is several miles away and which is free of reflections from mountains or other objects that can obscure the polarity and the directivity of the sent signal. It will be found that the directivity patterns of this antenna will be different from those charts which have been published for horizontally polarized quads. One of the most noticeable characteris-

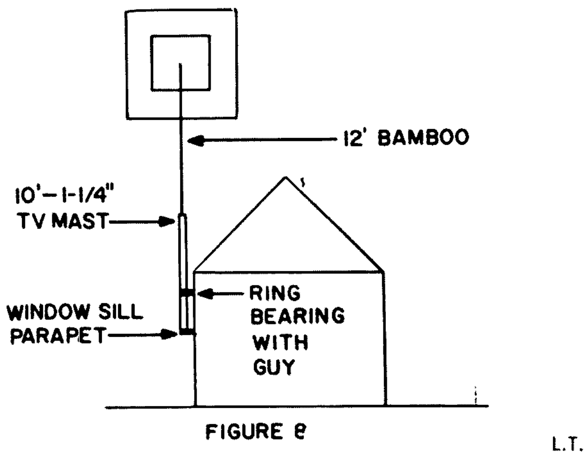


FIGURE 8

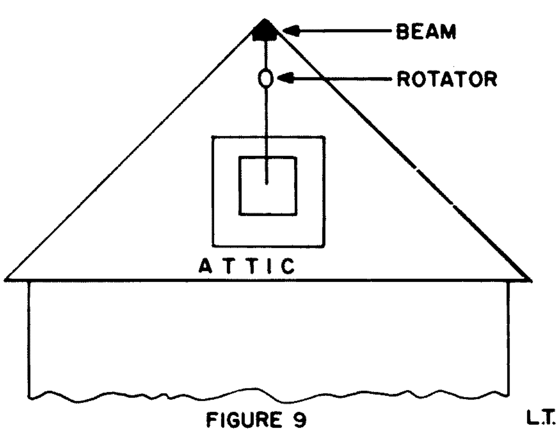


FIGURE 9

tics of any horizontally polarized array is its dramatic front-to-side ratio; but this effect is not as pronounced in the vertically polarized quad. This 6 and 2 meter antenna has a cardiode pattern as shown in the graph of Fig. 7. This collection pattern was plotted on six meters over a clear optical path between Mount Wilson and the San Fernando Valley. In this case, the receiving equipment used was a Hallicrafters SX 110 and a Vanguard converter. The reflectors were not adjusted in any way and Fig. 7 shows the kind of directivity that can be expected by the builder. As compared with the front, signals fall off 15 to 20 db on the sides and back; the slot in the center of the back may be as much as 42 db deep. This rejection slot is handy for excluding unwanted signals and can be used to prevent receiver overload when strong locals are being worked. When making tests for front-to-back and front-to-side ratios, the checks should be made under several path conditions before any major correction is applied to the antenna. Misleading readings can be obtained due to the many factors which may disguise the true performance of the array. If your station receiver has no "S" meter for making these comparisons, the antenna can be checked by sending to a station having such an indicator. A field strength meter can be used for checking the quad but it should be at least 500 feet away from the transmitting site.

Masts

The light weight and small size of this array permits a variety of support systems to be used to get it up to a useful height. The operating parameters of this quad require that it be at least one half-wave above the ground, or a metal roof. This works out to be only ten feet at six meters and presents no real problem. The quad in the photos is worked on a 12 foot bamboo pole which has a 10 foot length of TV mast ferreled onto its bottom end. This combination is manually rotated in a pipe socket which was driven into the ground just outside the shack window. This arrangement requires no guys and is easily dismantled for Mountain Topping and other field work. Another support and rotation method which suggests itself is the use of an upstairs window sill parapet as the mast support. (Fig. 8). With this arrangement, the mast should be bearing guyed as it passes the eave of the roof. The short turning radius of this 6 and 2 beam allows it to be used within an attic as seen in Fig. 9. The builder can attach this quad to a previously erected fixed or rotating mast as the antenna is being assembled. Construction of the array is carried out as described earlier except that the reflectors are left off. They are added after the quad has been clamped to the mast. A motorized or lanyard operated flip-flop arrangement can be employed if frequent polarity changes are desired.

. . . W6SFM

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PAQUHOWWAMOMAM*

(Putting a Quad Up Half One Wave With A Minimum Of Money And Manpower)

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East Aurora, New York

If you have just made the final payment on that umpteen-foot-high status symbol or whatever, supporting a rotary in your backyard—all you can possibly get out of this article is the urge to laugh derisively. Maybe that will help your subconscious. If you haven't yet spent your money and want to stimulate your own thinking a bit on the subject of getting a 14 mc or triband quad high enough off the ground to do some good, read on.

Much has been written [1] concerning the design and construction of cubical quad antennas, but aside from occasional references to the fact that tilt-over towers were an effective method of getting them to altitude and back alive to adjust stubs, etc., past authors have been strangely silent on the subject of getting them UP. There have been frank admissions regarding the difficulty involved—"The thing has no handle," etc.—but generally the actual job of plugging all that bamboo and wire into a rotator on top of a tower has been left to the reader's imagination.

The Scheme

As we said before, if you already have a suitable tower or the ready where-withall to obtain one you probably won't be interested in a method that costs only twenty bucks—that takes up not one square inch of real estate—that keeps you and others from stumbling over guywires—and that puts the stubs within easy reach required.

All you need besides a ten-foot tripod, a ten-foot and a five-foot TV mast, something under a hundred feet of guy wire, and assorted screweyes, turn-buckles, thimbles and cable clamps for three guys. . . is a garage. Or maybe even a carport. Even a house will do. Seriously, to make this scheme work as easily for you as it has for me, you should have a building with a ridge pole some ten to fifteen feet above ground level. Any less than these limits, and you will have to settle for less than thirty three feet to the quad's midpoint. Any more and you will have a helluva time getting the thing on top of the roof. You may not have a spare unattached garage lying around as I did, but if you have a one-story garage attached to anything from a ranch to a two-story house you're still in business provided that the second ridge is no more than ten feet or so above the first.

By now you're probably wondering about the arithmetic involved and maybe even why we want to put this thing a half wave above ground. Various authorities [2] have commented on the fact that a quad will do a better job relative to a Yagi when both are handicapped by low elevation. In fact 601ND gave me a 579 during an SWR check while the quad reposed at half mast so to speak, awaiting an antenna party to get it up the final twelve feet. Incidently, the SWR was 1.5/1. But I digress. Anyway, if you just joined the class, we want our antenna a minimum of one half wave above ground to attain 1) useful radiation pattern, and this means low angle of radiation for DX work 2) actual impedance approaching characteristic feedpoint impedance and thus low SWR. This may be a good point to mention that using Orr's dimensions for a single band 14 mc quad and feeding same with RG-11/U resulted in a standing wave ratio of less than 1.1/1 after arriving at thirty three feet. But again I digress. Back to the arithmetic.

I have a one car garage twelve feet by twenty feet with a ridge pole twelve feet in the air. Add ten feet for the tripod (actually you lose a few inches mounting the tripod

astraddle the ridge, but you get this back in the space taken up by the AR-22 or equal); add another seven to eight feet for the push-up mast, and another four to five feet for the stub mast from top of rotator to boom—and your home free, or at least thirty three feet in the air even if you started from a point only ten feet off the ground.

Mobilizing for Action

Now that you know what is involved, perhaps you would like to hear how I went about it. Please note that what follows is *not* a set of instructions. It's nothing more than an account of how one low-budget ham beat the high cost of skyhooks. So if you fall off the roof and disfigure the XYL's prize rhododendrons, or maybe wind up in the hospital, don't bother to write me threatening letters. I promise they will go unanswered.

The first thing I did after acquiring all the hardware was to mount the tripod on the garage roof and install the screweyes for the guys. Since you, or whoever you might con into the job, will have to climb the tripod later, I would suggest you do a workmanlike job of it. I used scrap lumber backing up the plywood roofdeck between joists, and thru-bolts—plus a little roofing compound to forestall leaks.

This much accomplished, I began work on the quad. I used U-bolts to secure the spreaders to foot-square pieces of five-eighths inch plywood and attached pipe flanges to the plywood bored to accept a one-and-one half inch dia. aluminum boom. I then assembled the respective elements flat on the ground, one atop the other. The elements completed, I lashed the ten-foot mast vertically alongside a clothes pole. If you don't have a clothes pole handy, you might try sinking the end of the mast into the ground and temporarily guying it in place. With the aid of a stepladder the boom was then attached normally to the mast at a point approximately nine feet above ground using a one-quarter inch aluminum plate and U-bolts. After this it was a simple matter to pick up the elements one by one and slip the pipe flanges over the ends of the boom. The first flange was drilled and bolted to the boom at random and the process was repeated on the other element after alignment with the first. The quad itself was

[1] We won't bore you with the usual bibliography. The past five years of QST and CQ contain some two dozen articles on quad dimensions and construction techniques. Just check your year-end indicies. Or get a copy of **All About Cubical Quad Antennas**, Orr W6SAI, 3A2AF

[2] Take my word for it.

thus completely assembled as a one man operation.

For what follows the services of two additional helpful types were required for perhaps half an hour. Before arranging for their time however, I a) secured the guys to the rotator b) taped U-shaped pieces of strap iron to the tops of two twelve foot bamboo poles, heavy ones which came inside of rugs, and c) opened up the bottom wire of both driven element and reflector at the insulators, and taped the wires to adjacent spreaders. Those of you with good perception will note that this takes a healthy ninety degree segment out of the bottom half of our nearly cubical gadget. To facilitate disassembly of the wires and to make later attachment of the feedline easy, I ran 10-32 plated brass machine screws thru holes in the ends of the insulators and secured elements, stub and eventually feedline with nuts. You will shortly discover that step c) above is the clue to getting this rather unwieldy object in place on top of the tower.

Up With It

After the reinforcements arrived, I had one of them climb the ladder to the garage roof. The other one stabilized the quad while I untied the mast from the clothes pole. Next I picked up the mast, quad and all, and walked it across the backyard approaching the garage with the boom in line with the ridge pole. When the lower end of the mast was at waist height the boom was a foot or so above the ridge. If your ridge is over twelve feet, you can climb a stepladder placed half the boom length away from the end of the building to get the boom above the ridge. The lower spreaders were then eased forward against the edge of the roof somewhat below, and astraddle the ridge. By raising up still further on the mast the boom was thus tilted toward the man on the roof. He simply reached thru the spreaders, grabbed the boom, and then picked up the entire assembly. With the end of the boom against his thigh, and the boom tilted up at about forty five degrees, he walked backward down the ridge toward the tripod tower.

At this point we joined him on the roof, brought the mast to the vertical, raised it enough to enable the boom to clear, and then centered the boom on the tripod. Next we taped the feedline to the boom, leaving enough coax to reach the feedpoint once the lower wires were rejoined at the insulators. This accomplished, we tied the boom to the top of the tower thus raising the tips of the spreaders above the roof line and connected the bottom wires and feedline. At this point we were forced to vacate the roof owing to an approaching thunderstorm—hence the opportunity to check SWR at twenty one feet and get a report from 6O1ND.

When the antenna party reconvened, I roped myself to the tripod so as to have both hands free; loosened the U-bolts holding the ten-foot mast to the boom, removed the mast and inserted it down thru the top of the tower. I then clamped the rotator, guys trailing, to the top of the mast left projecting above the tripod. The upper end of the five-foot mast was then clamped to the boom. Finally, using the hook-equipped twelve-foot poles, my fellow roof dwellers raised opposite ends of the boom an additional five feet (I untied it first), and reaching up I guided the lower end of the stub mast into the top of the rotator. After cinching up bolts, further taping of feedline, etc., yours truly came down off the upper rungs of the tripod.

Now the quad's centerline reposed about twenty-six feet above the garage floor; the lower element wires about six feet or so above the roof, which put the stub shorting bar within easy reach. After tuning the reflector, it was a simple one-man job to raise the pushup mast a final seven feet, slip a board across the tripod rungs beneath the end of the mast for temporary support, and snug up the bolts holding the mast in place. The last step was attachment of the guys to the screw-eyes via turnbuckles, which were then adjusted, and the job was considered finished.

More on Construction

Those of you who succeeded in overcoming the urge to laugh at my antics might be interested to know that the cash outlay for the entire antenna system; tower, rotator, and quad material came to less than the cost of a new AR-22. I'll admit this does not include the coax, multiconductor rotator cable, or the six cans of beer consumed by members of the antenna party. Nor does it include the carton of cigarettes gratefully presented to a local greenskeeper after he supplied us with eight selected bamboo poles (the poles are used to swish dew off the greens in the morning, I'm told). But it does include tripod at fifteen dollars; masts, guy wire and assorted hardware at five dollars; one hundred and fifty feet of #14 copper wire, eight-foot do-it-yourself aluminum boom, vinyl tape and other sundries for five dollars; and a used CDR

rotator at ten dollars. The plywood was obtained from lumber yard scrap for two-bits, and the U-bolts were made up by running a die over opposite ends of five-inch lengths of three-sixteenths brass rod I had on hand, bending about a piece of pipe and covering with spilt sections of old windshield wiper hose.

Addendum

By any standards, I feel that this was money well spent. Within two weeks after climbing off the roof 20 CW yielded VR2DK, VP8GQ, KR6MO, ZK1BY, VQ5IU, and 9U5BH—plus assorted JA's, VK's, UA's, etc., with reports ranging from S5 to S8. Rig used was a venerable DX-35 panting into a homebrew 811A linear.

I can't kid myself about the value of antenna comparison info coming from a neophyte who has yet to wear out his first General ticket, and who for that matter has never had a commercial antenna tied to his rig—but for what it is worth I will say that this quad definitely outperforms a previous homebrew, interlaced, two element 15-20 Meter beam. Besides superior ability in the face of pileups (remember the mob on Gus during his 9U5 stint?), its performance during reception is perhaps even more significant. I find I'm listening to and working a whole new layer, particularly far Pacific, that I never knew existed at this QTH.

Finally, to forestall queries from some of you astute types, I will say that preliminary investigation indicated no appreciable change in SWR with the car in or out of the garage. I had early visions of combating QSB with visual signals to the XYL behind the wheel, shuttling in and out of the garage. For a variety of reasons, perhaps needless to say, this has not come to pass. . . . K2AAC

Three Elements on Three Bands

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"Darn. Beat out again! Gotta do better. Can't waste my life away calling DX. Time to *work* some. Quads have appeal. But not another *ordinary* quad. RSGB Bulletin (March 1959 pg 432) and VE3IT have the idea—a three element quad. His quad is built with a 14 foot steel 1¼" boom. It only covers 28 mc but I could put it on 14 and 21 mc also."

There has been considerable controversy about the gain of a quad. Many people have claimed a 3 element quad was no better than a 2 element. Let's look at the quad in the following way. Consider an ordinary 2 element parasitic beam at optimum spacing. Its theoretical gain is on the order of 6 db while 5.5 db may be realized in practice. Even if the element ends are drooped as in the case of the Weeping Willow Antenna of ZL2AFZ approximately the actual gain of the non drooped beam may be realized. ZL2AFZ has built a 3 el 14 mc parasitic beam with the usual element length but has made it into a Weeping Willow. This is done by inserting 90° bends in the elements one quarter of the particular element's length from each of its tips. A 2 element version of the Weeping Willow is drawn in Fig. I.

If a second Weeping Willow antenna is now stacked below the first one, and fed simultaneously with the first one, approximately 3 db stacking gain can be obtained or a total of 9 db. Suppose that instead of connecting the feedpoints of the two Weeping Willows together that the bottom or second one is inverted. It is fed by connecting its element tips to those of the first Weeping Willow. Then the feet point of the first will be sufficient to feed the entire array. See Fig. 2.

The resulting antenna is called a cubical quad. If two 3 element Weeping Willows (as used by ZL2AFZ) are combined in this way to form a quad a stacking improvement of 3

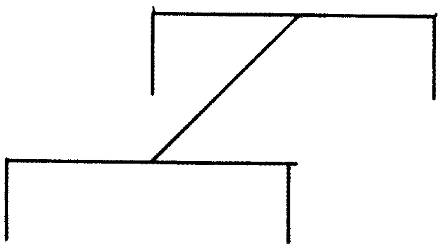


FIG I

The Weeping Willow 2 element parasitic beam of ZL2AFZ's design.

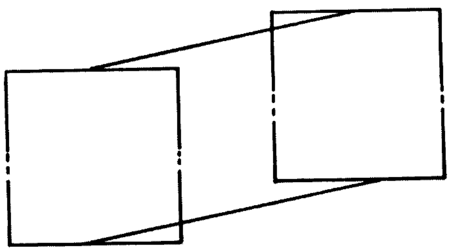


FIG 2

Stacking the two Weeping Willows to get some 9 db. gain.

Designer	Design Frequency mc., F	Director feet	Driven el. feet, D	Reflector feet	Constant FD
VE3IT	28.25	31.9 plus stubs	33.5	33.5 plus stubs	948
KR6CG	28.6 (estimated)	32	34	36	972

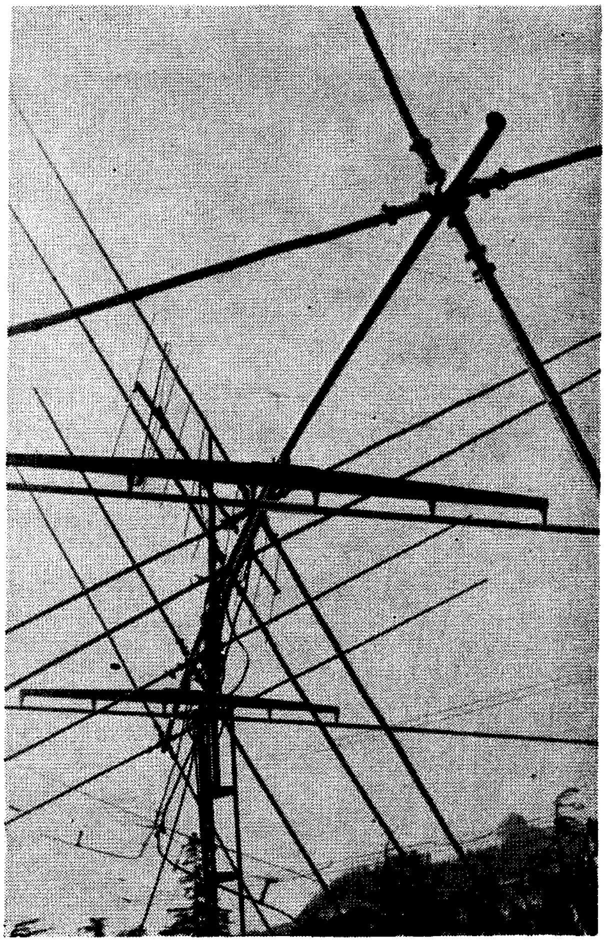
Table 1

db will be expected. The actual gain of a 3 element parasitic beam of optimum design is 9 db thus this 3 element quad should have forward gain of 12 db over a reference dipole standard. This figure of 12 db seems quite reasonable since measurements of the Cubex Co. made at a commercial antenna range on 2 element quads at 21 mc and at 28 mc with spacings of 0.19 to 0.25 wavelengths gave forward gain figures of 9.8 to 10.0 db.

VE3IT was one of the first to publish an article on the construction of a 3 element quad. KR6CG also built a 10 meter 3 element quad. The dimensions of these quads are in Table I.

With the success of VE3IT in mind I thought that I might do even better by building a tri-band system of 3 element quads. Rather than complicate things by changing his dimensions and spacings it was built using exactly the same dimensions on 28 mc. On 14 and 21 mc the element lengths were directly proportionately longer. The element spacings were 0.20 between director and driven element and also between driven element and reflector. In order to maintain this equal spacing on each band a total of 5 spiders on a 30 foot long 2 inch diameter aluminum boom were used. The boom was attached to a two inch OD waterpipe mast about 2 feet above the rotor by means of a boom to mast fitting supplied by Cubex. The AR22 rotor (adequate for rotating but not for holding this antenna is one direction on a windy day) was mounted on a 55′ crank up tower. For additional support of this boom 18′ of 1½″ OD water pipe was run parallel to it beneath it and clamped to the boom with large TV antenna—vent pipe aluminum clamps. (This piece of pipe also served as a boom for a loaded two element 7 mc parasitic beam.)

The standard 2″ bore aluminum castings supplied by Cubex were used with 13′ pieces of bambo clamped in them as spiders. Hose clamps were used. See Fig. 3. The bamboo was well covered with spar varnish before use. (It is difficult to obtain bamboo in many areas of the country. Consult the yellow pages of your telephone book. The Sea and Jungle Shop, Glendale, Calif. has a large permanent stock and will ship quality bamboo.)



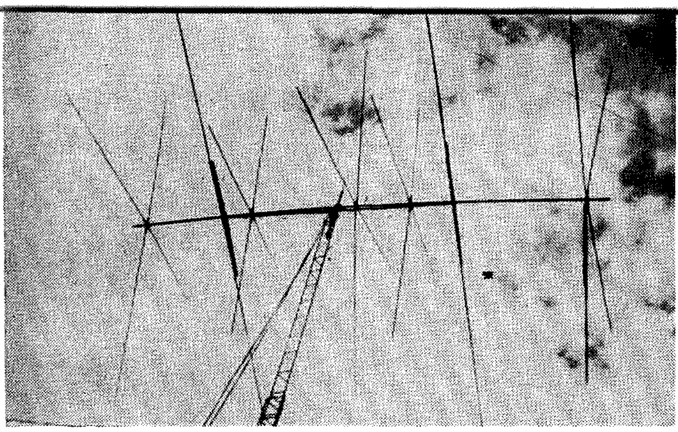
Quad closeup. A 10 element 2 meter beam in center.

The arrangement of the elements is shown in Figs. 4 & 5.

Elements were made from soft #14 copper wire. The corner of each element was attached to the bamboo support arm with another loop of wire. This loop ran through a hole drilled in the very tip of the arm and thus the element could be loosened or tightened as required by varying the length of the loop.

Electrical Construction

As I have mentioned the original element lengths were calculated by the use of the 948 FD constant of VE3IT. The resulting resonant frequencies (estimated from SWR measurements) were 15025, over 22500, and over 29600 kc. The corresponding driven element lengths were 69.4 46.3 and 34.5 feet. By the addition of tuning stubs to each element it is possible, altho not too practical, to resonate the quads. The stubs were several feet long. Large coils made from loops of wire one to three feet long as required were added in pairs, three feet from the center of each element to increase its length. The elements were thus extended to employ the more recently



View of complete quad.

published constants described in letters to QST by W1WTF, W2GJD, and W5GGV (as reproduced in the Malayan Radio Amateur, March/April 1959 pages 15-17). W1WTF reports the constant FD as 1004 from 10, 15, and 20 meter measurements by W1ALK, W1HTR and himself. W2GJD reports FD as 1004 on 10 and 15 meters and as 1042 on 20 meters in a 3 band quad, as 1022 in a one band quad, and as 1012 in a two band (10/15 meter) quad. W5GGV obtained FD of 1004 on a 14 mc quad in the air (QST, April 1957). From my own experiments the values derived for this quad are in Table II. The F of Table II is the point of minimum SWR for the quad measured 56′ above the ground after tune up. Note that the geometry of the coils used may vary these dimensions slightly.

The quads were all fed with 52 ohm RG8/U coaxial cable through gamma matches. The gamma matches were constructed by removing the copper braid from RG8/U coax and slipping the portion remaining through a length of ¼″ aluminum tubing to form a condenser. Shorting bars were made of aluminum strips ½″ wide, ⅛″ thick. Gamma match rods were spaced about three inches from the wire of

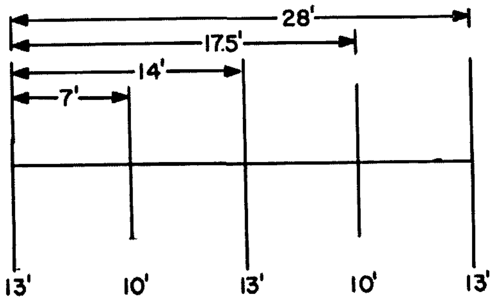


FIG 4

Bambo Length feet	13′	10′	13′	10′	13′
Band					
14	Director	—	Driven	—	Reflector
21	—	Director	—	Driven	Reflector
28	Director	Driven	Reflector	—	—

Element spacings for the three element quads for three bands on one boom.

Designer	Design Freq. mc., F	Director feet	Driven el. feet, D	Reflector feet	Constant FD
K6DDO	14.050	68.2	71.6	75.2	992
K6DDO	21.100	45.45	47.75	50.2	1002
K6DDO	28.200	34.1	35.8	37.6	1010

Table II. Element lengths

the driven elements. The following measurements of SWR from the quads in the air were obtained: 14000, 1.35; 14050, 1.30; 14350, 1.85; 21000, 1.25; 21100, 1.05; 21450, 1.40; 28000, 1.30; 28200, 1.07; 28800, 1.90; 29600, 3.20. The adjustment of the gamma capacitors was not too critical and the distance of the shorting bar from the center of the driven element was 2′ on 10 meters, 3′ on 15 meters, and 4′ on 20 meters.

Front to back ratios were on the order of 30 db on each band in local tests. Front to side ratios ran as high as 50 db for locals but these ratios were variable in the case of skip signals.

Results

In two months of routine CW and Phone operation during poor summer conditions from the middle of July to the middle of September I worked my second WAZ and my second DXCC and had good success in pile ups. The quad readily beat out any sort of loaded or trap beam and was somewhat better than 2 element quads and 3 element beams. It had a signal comparable to a well designed 6 element Yagi. About 1000 DX QSOs were made in these two months.

The quad rode through the second highest winds ever recorded in Los Angeles, 48 MPH (49 MPH is the record), in fine style only to have the tower knocked from under it by a falling 2 X 4 mast the next day. It survived a windstorm in which some 150 trees in Hollywood and vicinity were blown down.

The most enjoyable feature of this antenna was that we could call CQ once during a band opening to Europe and usually be assured of plenty of DX calling in reply. It was possible to raise one station on the CQ and have DX stations then call for a couple of hours afterward as contacts were completed. Since then many 3 element quads have been built. Some of the big quads can be found at VK3AHO, W4AZK, W5SVP, K6BPY, K6CT, WA6HUM, K6PRU, and K7HXB.

In conclusion I wish to thank my family, K6CEO, K6IDA, W6RW, the Cubex Co., VK3AHO and the others who helped with the project.

. . . K6DDO

Propagation

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
Alaska	14	14	14	7	7	7	7	7	7	14	14	14
Argentina	14	14	14	7	7	7	14	14	14	21	21	21
Australia	14	14	14	7	7	7	7	7	7	7	14	14
Canal Zone	21	14	14	7	7	7	14	14	14	14	21	21
England	14	7	7	7	7	7	14	14	14	14	14	14
Hawaii	14	14	14	7	7	7	7	7	14	14	14	14
India	7	7	7	7	7	14	14	14	14	14	14	14
Japan	14	14	7	7	7	7	7	7	7	7	14	14
Mexico	14	14	14	7	7	7	14	14	14	14	14	14
Philippines	14	14	14	7	7	7	7	14	14	7	14	14
Puerto Rico	14	14	7	7	7	7	14	14	14	14	14	14
South Africa	7	7	7	7	7	14	14	14	14	14	14	7
U.S.S.R.	14	7	7	7	7	14	14	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
Alaska	14	14	14	14	7	7	7	7	7	7	14	14
Argentina	21	14	14	7	7	3	14	14	14	14	21	21
Australia	21	21	21	14	14	7	7	7	7	7	14	14
Canal Zone	21	14	14	14	7	7	7	14	14	14	21	21
England	14	7	7	7	7	7	7	14	14	14	14	14
Hawaii	14	14	14	14	7	7	7	7	14	14	14	14
India	14	14	7	7	7	7	14	14	14	14	14	14
Japan	14	14	14	7	7	7	7	7	7	7	14	14
Mexico	14	14	14	7	7	7	7	14	14	14	14	14
Philippines	14	14	14	7	7	7	7	7	14	14	14	14
Puerto Rico	21	14	14	7	7	7	14	14	14	14	21	21
South Africa	7	7	7	7	7	7	14	14	14	14	14	14
U.S.S.R.	14	7	7	7	7	7	14	14	14	14	14	14

WESTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
Alaska	14	14	14	14	7	7	7	7	7	7	7	7
Argentina	21	14	14	7	7	3	7	14	14	14	21	21
Australia	21	21	21	14	7	7	7	7	7	7	14	14
Canal Zone	21	21	14	14	7	7	7	14	14	14	21	21
England	14	7	7	7	7	7	7	7	14	14	14	14
Hawaii	14	14	21	14	14	7	7	7	14	14	14	14
India	14	14	14	14	7	7	7	7	14	14	14	14
Japan	14	14	14	14	14	7	7	7	7	7	14	14
Mexico	14	14	14	7	7	7	7	14	14	14	14	14
Philippines	14	14	14	14	14	7	7	7	7	14	14	14
Puerto Rico	14	14	14	7	7	7	7	14	14	14	14	14
South Africa	7	7	7	7	7	7	7	14	14	14	14	14
U.S.S.R.	14	7	7	7	7	7	7	14	14	14	14	14

July Forecast

Good: 1-2, 9-10, 12-13, 16-19, 22-23, 26-31

Fair: 3-5, 8, 14-15, 21, 25

Bad: 6-7, 11, 20, 24

Es: 8-9, 12-13, 29

Es means the possibility of a high MUF and/or freak conditions.

Items of Interest

1. We are presently about one year from the minimum portion of the 11 year sunspot cycle. Monthly average sunspot numbers this year have been January 19, February 23, March 17, April 30. May is also showing an increase over March but this is temporary and the numbers should fall again. The last year comparable to the present was 1953 preceding the low of 1954. In 1954 the sun was nearly bare of spots for the first six months.

2. The useful frequencies of 1963 are almost identical to what they were in 1953 and signal qualities also show the same pattern. At this portion of the 11 year cycle, the Winters are bad and the Summers are quite good.

3. During the 22 orbits of Cooper's wonderful mission the Sun carried three sunspot groups one of which was as large as any sunspot the sun has produced in the past two years. This large sunspot, however, was quiet and actually improved radio conditions by raising the MUF; and on May 16th radio conditions for the astronaut's flight were perfect on both Atlantic and Pacific paths. The early part of the 15th, however, was slightly below normal on Pacific paths due to absorption.

J. H. Nelson

Active SSB Modulators

Staff

An earlier portion of this series of articles on sideband might have led you to believe that *only* diode modulators are used in modern sideband circuitry.

Tain't so. "Active" modulators—those involving tubes or transistors, and thus capable of providing some amplification of the signal instead of mere loss—are also widely used.

It's common knowledge, of course, among active sidebanders, that active modulators are used. But many active sidebanders seem to believe that only a few such circuits exist.

This ain't so either. A search of the literature going back to the earliest days of the current sideband boom (early 1948) revealed a minimum of 15 circuits. Each of these, of course, is subject to an infinite number of minor variations as well.

Before we dive into the intricacies of these 15 circuits, though, let's make some comparisons between active modulators and those of the diode variety. You just might not want to wade through all the active-modulator circuits—and then again you might.

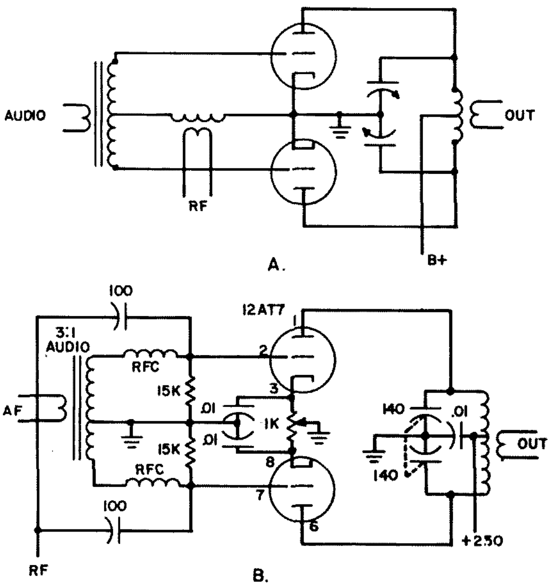


FIG. I

A. Basic Circuit
B. Practical Circuit
Push Pull Balanced Modulator

The major characteristics of the diode modulator are its simplicity, low number of components, absence of power-supply requirements, and relative freedom from aging.

The active modulator, on the other hand, has (in addition to the opposite of all the characteristics just mentioned) the capability of amplifying the signal instead of just producing losses.

For a given amount of rf output power, you're going to have to use about the same number of active devices. The real choice, then, becomes one between a diode modulator plus an extra linear amplifier, or an active modulator without the amplifier.

And viewed in this light, it becomes one of those things about which there is much difference of opinion. Some people prefer to battle it out with the amplifier, while others prefer to fight their problems with the modulator.

If you're interested in going *double* sideband instead of single, then the active modulator is recommended. You can build one of these to operate at a kw if you like, and avoid *all* amplifiers (such a circuit, although for a more practical power level, is included in our list).

Ready to look at circuits? Let's get with it.

One of the most basic of the active modulator circuits is that shown in Fig. 1, the push-pull balanced modulator. Fig. IB shows the practical version of the circuit, including balance control and means for routing rf and audio to their proper places.

This circuit works something like an electronic switch, turning the carrier off and on under the control of the audio (or other modulating signal—wherever "audio" is mentioned in this article, rf of a different frequency than the carrier can be substituted equally well and then the circuit becomes a "mixer").

Thus, when the grid of the upper half of the tube (in Fig. 1) becomes less negative, more of the carrier flows through this tube. At the same time, the lower grid becomes more negative, cutting off carrier flow through this half of the tube.

The carrier is eliminated because it affects

both grids equally and plate current in both halves of the tube goes in the same direction at the same time. This current flow cancels itself out in the push-pull tank circuit.

However, incoming audio drives one grid positive while the other goes negative, allowing current to flow more through one half than the other as mentioned earlier. This flow, being different in the two halves of the tank circuit, does *not* cancel out—it shows up instead in the output as the sidebands, less the carrier.

The *modified* push-pull balanced modulator of Fig. 2 works the same way. Carrier is injected into the cathodes of both tubes, in phase. Audio is injected into only one; it affects the other because, for audio, the two tubes form a "long-tailed-pair" phase inverter circuit.

This phase inverter is worthy of special mention. The secret of its success is the 33K resistor in the common cathode circuit. In addition, the resistive loads in the plate circuits are necessary.

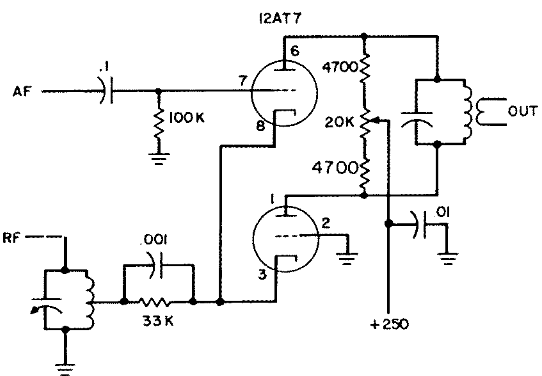


FIG. 2

Modified Push Pull Modulator

Under these conditions, the upper tube acts a little like a cathode follower for the audio coming into its grid. The audio appears across the cathode resistor, which is much larger than the plate resistors. The lower tube, then, functions as a grounded-grid amplifier. However, the upper tube in addition to being a cathode follower acts a little like a conventional amplifier too.

A conventional amplifier shifts the phase of incoming signals 180 degrees; cathode followers and g-g amplifiers do not shift phase at all. Thus the audio signals at the two plates must differ by 180 degrees—and this implies that the audio at the two grids also differs by the same amount, thus satisfying the requirement for push-pull input!

Both the circuits we've seen so far use push-pull input and push-pull output, with the modulating signal applied in parallel. Now let's look at one which uses single-ended output.

This is the push-push balanced modulator

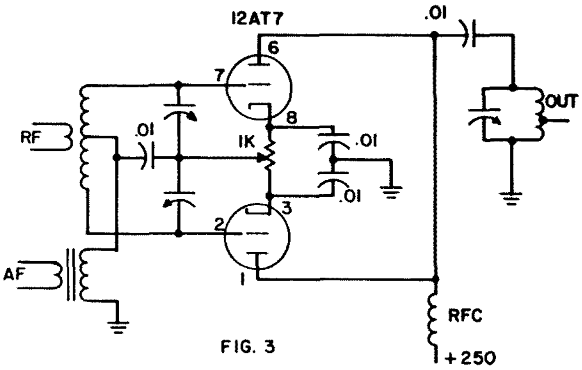


FIG. 3

Push Push Balanced Modulator

of Fig. 3. So far as the rf circuit is concerned, this circuit is identical to the push-push frequency doubler with one exception. The output circuit is tuned to the same frequency as the input.

Carrier is balanced out because one of the two tubes is always conducting (in the absence of audio) and the plate-current pulses fill each other in. You might say they beat each other's brains out at the tank circuit.

However, with audio applied, the non-linear properties inherent in any class C amplifier cause some mixing action to occur—and because of the complex phase relationships in the mixing process these sideband components do *not* cancel out in the tank circuit.

In many ways this is a simple and effective circuit. However, the push-push action tends to accentuate even-order harmonics; watch out for them if you use this one.

The circuit of Fig. 4 is called the "unbalanced balanced modulator" in W6TNS's handbook; the ARRL sideband handbook identifies it as a "transformerless" balanced modulator and credits it to Murray G. Crosby, W2CYS, inventor also of the triple-triode product detector.

Carrier balancing in this circuit is accomplished by the 10K pot in the carrier-input circuit. A portion of the carrier is picked off by this pot and fed, out-of-phase, to the output circuit. The adjustable capacitor is used to neutralize capacative feedthrough in the tubes.

The major advantage of this circuit, aside from novelty, appears to be the exceptionally low distortion created. Crosby reports distortion less than ½ of 1 percent, using this design.

Another active modulator which does not require push-pull circuitry is shown in Fig. 5. This one is used in the KWS-1 for frequency conversion, but can also be used for audio modulation.

In the absence of audio input, the circuit acts as a long-tailed phase splitter for rf, and the out-of-phase rf is then cancelled out in the plate circuit.

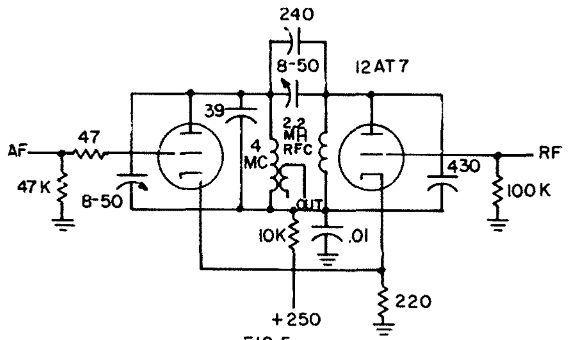


FIG.5

Collins Balanced Modulator

When audio is applied to its input jack, the balance conditions which produced the rf cancellation are upset, and the sidebands appear in the output. Suggested audio signal level is about one-tenth of a volt, while about 1½ volts of the rf are required.

All the active-modulator circuits looked at so far require plate-supply power. The circuit of Fig. 6, though, known as the "plate-modulated" balanced modulator when By Goodman, W1DX, first described it in the November, 1949, QST, requires no power except for the filaments.

The principles of operation here are very similar to the circuit of Fig. 1, except that the audio is fed to the cathodes rather than to the grids. Plate power is supplied by the audio input only, however. In the absence of audio, no

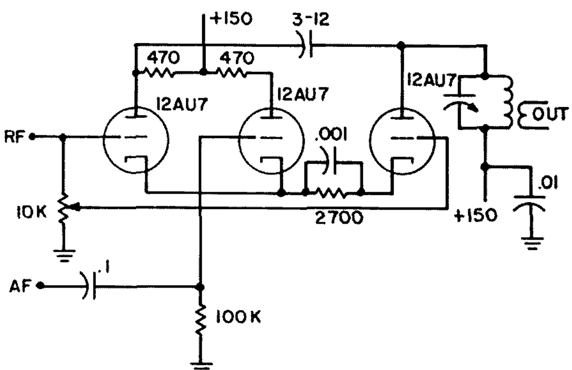


FIG.4

Crosby "Unbalanced" Balanced Modulator

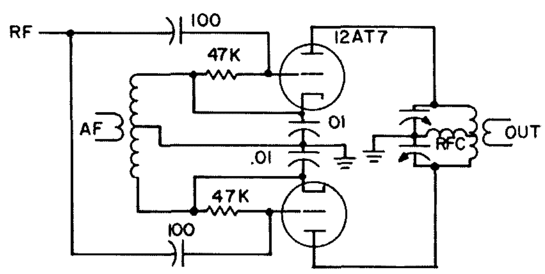


FIG.6

Plate-modulated Balanced Modulator

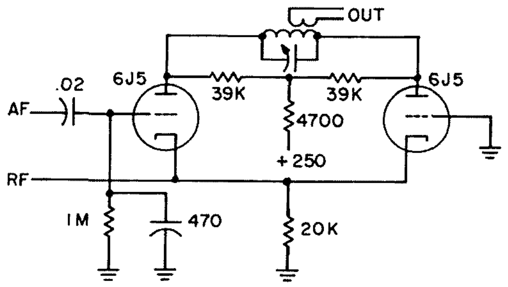


FIG 7

W7BMF/Motorola Balanced Modulator

power is applied to the stage and nothing naturally, gets through. When audio is applied, one cathode goes positive while the other goes negative. The tube whose cathode is positive does nothing—but the one whose cathode goes negative can then amplify so long as the audio half-cycle lasts, and routes carrier and sidebands through to the output. The carrier balances out in the push-pull tank, leaving the sidebands.

The circuit shown in Fig. 7 is credited to W7BF in its first published appearance, with the note that it is "swiped from Motorola." Its major feature is that it does not require push-pull input for either the audio or rf signal; rf input is to a 20K cathode resistor common to both tubes, while the audio signal is phase-split by the pair acting as a long-tailed splitter.

In many ways, this circuit is similar to the one shown in Fig. 2. The major differences are the high-impedance untuned rf feed to the cathodes, and the RF filter included in the audio input circuit.

All of the active modulator circuits discussed so far give only DSB output; the circuit in Fig. 8, first described several years ago in QST by VE6CN, allows a choice of DSB or phase-modulated output.

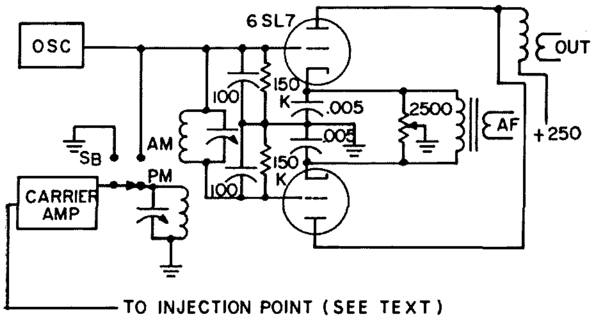


FIG. 8

VE6CN Phase-or-sideband Modulator

This circuit is very similar to the push-push modulator of Fig. 3, with the changes all being in the circuitry between the oscillator and the rf input to the modulator.

With the switch in the sideband position, rf input to the two grids of the modulator tubes

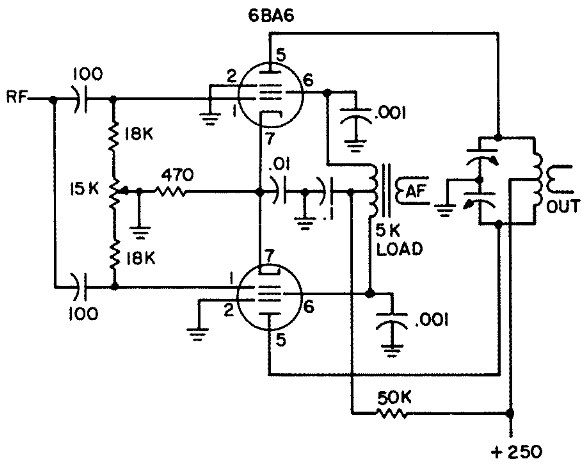


FIG. 9

Pentode Balanced Modulator

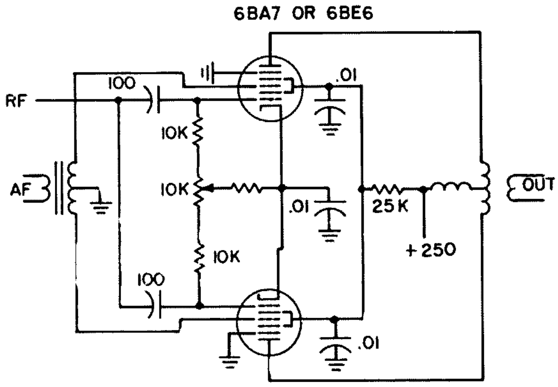


FIG. 10

Pentagrid Balanced Modulator

is applied in push-pull. Filtered sideband output goes on through the transmitter. In the AM position, the same action takes place except that a portion of the rf input is also applied to the "carrier amplifier" and is re-inserted in a stage following the filter. And in the PM position, carrier voltage 90 degrees out of phase with that applied to the modulator is applied to the carrier amplifier.

The 90-degree phase shift between re-inserted carrier and the sidebands produced by the modulator result in phase modulation. This circuit allows good deviation to be obtained without multipliers.

Up until now, we've been looking only at those circuits which use triode tubes. However, pentode and beam-power tubes can also be employed, as can transistors and one type of tube specially made for balanced-modulator service. We'll look at these circuits now.

Fig. 9 shows a balanced modulator using type 6BA6 pentodes. Rf input is applied to the grids in parallel while the output is taken from the plates in push-pull fashion. Audio is applied to the screens push-pull, and in the absence of audio input all the rf carrier balances out. The pot in the grid circuit allows complete balancing of the circuit.

When audio is applied, the tube whose screen goes positive at any instant draws more current than the other, unbalancing the circuit and allowing the sidebands to appear in the output tank.

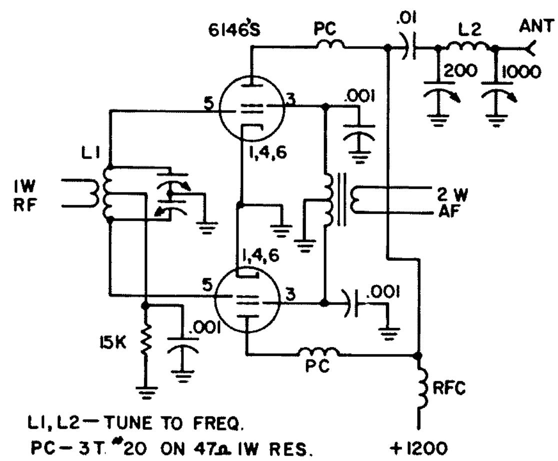
As shown, this circuit uses positive voltage on the screens. With a bit of juggling, the screens can be returned to ground and then current drain in the absence of audio will be almost nothing at all.

The pentagrid balanced modulator of Fig. 10 derives from a circuit originally described by Villard, W6QYT, in the April, 1948, issue of QST. This was less than 6 months after W6QYT triggered off the current boom in sideband by putting W6YX on the air SSB. It is seldom used any more because of cost of components, but still retains all its advantages of low distortion and easy adjustment!

This circuit operates in the same manner as the pentode circuit of Fig. 9, except that the audio signal is applied to grid-3 instead of to the screen in each tube. Interaction between audio and rf signals is minimized by the screening action of grids 2 and 4.

Though most balanced modulators operate at low signal levels, they need not necessarily do so. The circuit of Fig. 11 is widely used to produce a double-sideband output signal directly in the final stage, and depending on the tube type chosen can produce power ranging from watts to kilowatts!

This circuit operates in exactly the same manner as that shown in Fig. 9 except that the tubes are heftier. Grid input at carrier frequency is fed push-pull fashion simply to allow use of the popular pi-net output circuit.



L1, L2—TUNE TO FREQ.
PC—3T. #20 ON 47Ω IW RES.

FIG. 11

400-watt PEP DSB Modulator

Modulation is applied to the screens in push-pull.

With the 6146 tubes shown, plate voltage can be as high as 1200 volts. This is twice normal rating, but is no higher than the voltage applied during modulation peaks in AM service! To estimate allowable ratings for other tubes, double the voltage rating for AM service and use anything up to that figure. Current on peaks, though, should not exceed that rated for AM use.

Output power of this circuit, as shown, will be in the neighborhood of 400 watts peak. Maximum indicated input power will be only about 240 watts, however. No-signal plate current should not exceed 25 mils.

And while balanced modulators may operate at either high or low signal levels, they need not always use tubes or diodes. The circuit of Fig. 12 employs a pair of rf transistors.

This circuit operates identically to the triode push-pull modulator of Fig. 1; the differences are entirely due to the differences between tubes and transistors.

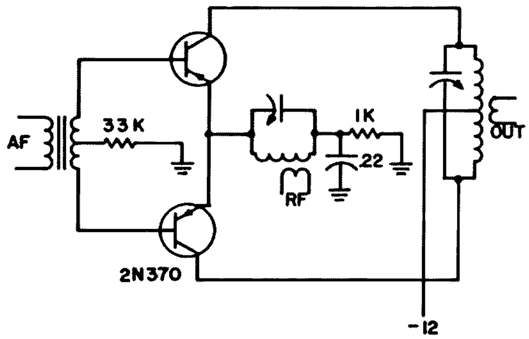


FIG. 12

Transistorized Balance Modulator

RF input is applied to the emitters in parallel, while the radio signal is applied to the bases in push-pull. Note that no base bias is present. Thus, in the absence of audio input the transistors and cutoff and cannot conduct; therefore, balance is not particularly critical.

When audio is applied, only that transistor whose base goes negative can conduct. Carrier balances out in the push-pull tank circuit, leaving only the sidebands to be amplified.

RCA type 2N370 transistors were specified in the original description of this circuit; the newer Amperex 2N2084 "universal" rf transistors should work equally well if not better, due to higher frequency ratings and greater power-handling capability. With 2N370's, power should be kept in the 10-20 *milli*watt region for reliable results.

The final active-modulator circuits we'll ex-

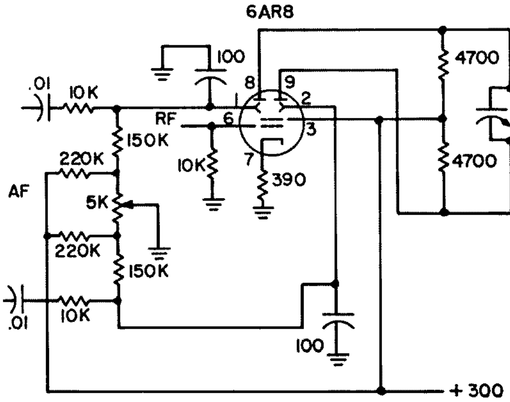


FIG. 13
Orr-Stoner 6AR8 Balanced Modulator

amine are those built around the sheet-beam tube.

This tube was originally developed for color television, and the first one to reach the market in any quantity was the type 6AR8. Bill Orr W6SAI, described a modulator built around this tube in the July, 1956, issue of CQ. The circuit of Fig. 13 is an adaptation of the Orr design.

Unfortunately, the 6AR8 is almost extinct now. However, RCA came out with a special tube designated the 7360 which performs the same function, and which in addition was especially designed for balanced-modulator use. With this tube, 50 db of carrier suppression is easily achieved and even greater suppression can be obtained with a little care.

The circuit shown in Fig. 14 is one recommended for use with the 7360. Note that it is quite a bit more complex than that of Fig. 13. Either should perform well with either tube.

Unlike all the other balanced-modulator circuits, the circuits of Figs. 13 and 14 operate by actual deflection of the electron beam within the tube.

The special tube contains a cathode and control grid, just like ordinary tubes, but then comes a pair of deflection plates (like in a scope tube) and two plates rather than one.

If carrier is applied to the control grid and push-pull audio is applied to the deflection plates, then the carrier signal will determine the amount of current flowing in each plate circuit while the audio signal will determine which plate circuit the current flows into.

The mechanics are actually very similar to those of the pentode modulator, in which the rf current available for each plate was the same but the audio signals applied to the screens determined which plate got the current at any given instant.

If the plates of the sheet-beam tube are connected in push-pull, then the in-phase rf from the control grid will cancel out in the absence of audio. Application of audio to the beam plates will unbalance the circuit, letting the sidebands show up in the output.

Undoubtedly, the circuits described here do *not* include all the possible active-modulator circuits. They do include most of them, though, and all those in wide use are discussed. For additional data on any one circuit, check the references below.

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ARRL Staff, **Single Sideband for the Radio Amateur** (first edition, 1954; second edition, 1958; third edition, 1962).

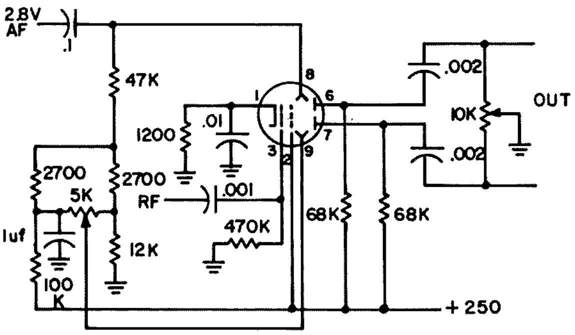
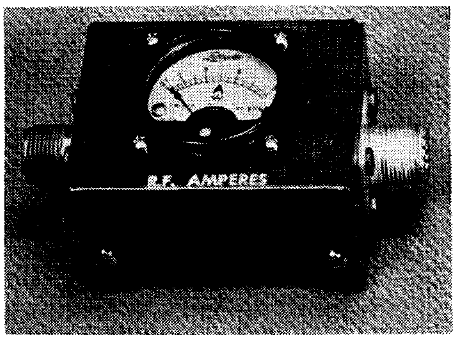
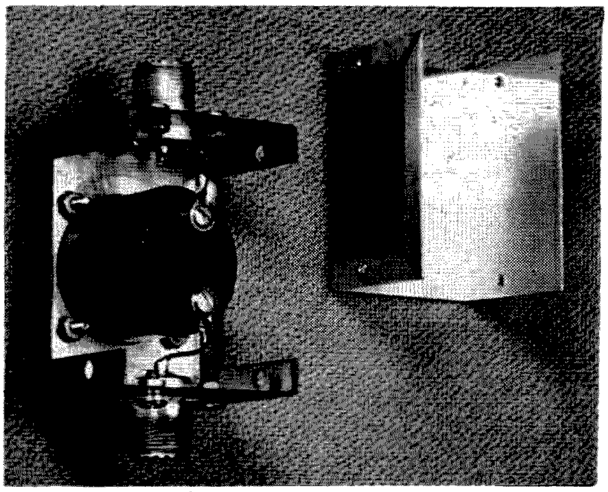


FIG. 14
Sheet-beam Modulator using type 7360



New Look in RF Ammeters

The amateur today can pick and choose from a wide variety of commercially available SWR bridges, impedance bridges, relative power indicators, absolute power indicators and other rf transmission system instruments. Although most of the factory assembled instruments are moderately priced, further savings may be realized by constructing one of the excellent kits



that are available. If you want to build from scratch, excellent designs are published in the handbooks and in the amateur magazines.

The very availability of this more sophisticated instrumentation has obscured the value and utility of some of the more primitive rf metering methods. An example of this is the old reliable thermocouple rf ammeter. Although more or less in general disfavor, the ARRL Handbook has described a packaged rf ammeter unit for several years. And well they should, since for sheer, un-ambiguous utility, the instrument is difficult to beat.

The photograph shows one version of the packaged rf ammeter, in this instance an imported, miniature 0-5 ampere unit. This meter is marketed by Lafayette Radio under their catalog number TM-500 and sells for $3.95. The meter mounts in a 1½" round hole and fits easily into the smallest available Minibox. The case shown in the photograph is a Premier PMC-1000 which measures 2¾" x 2⅛" x 1⅝". A pair of SO-239 coaxial fittings mounted on either end of the aluminum box completes the parts list. Wiring simply consists of an inch of #16 bare copper wire between the center contact of each receptacle and one of the meter terminals. The small size of the case and the short direct leads minimize the discontinuity introduced in the coaxial line by this instrument.

Use of the ammeter is simple and straightforward. Connect the rf ammeter in the 50 or 70 ohm transmitting transmission line, apply transmitter power and read rf current directly. Average power in the transmission line is easily computed by the formula, $P = I^2R$ where R is the characteristic impedance of the transmission line. With a reasonably low standing wave ratio in the transmission line, power output can be read quite accurately.

For those who have difficulty with mental

computations and can't find a pencil, the following chart gives the computed power levels present in nominal 50 and 70 ohm coaxial lines for various values of rf current:

RF CURRENT AMPERES	POWER OUTPUT IN WATTS 50 OHM LINE	70 OHM LINE
0.5	12.5	17.5
1.0	50	70
2.0	200	280
3.0	450	630
4.0	800	1120
5.0	1250	1750

All opinion to the contrary, the rf ammeter is not ready for retirement. Used alone or to confirm or supplement the power readings obtained by more refined techniques, the packaged rf ammeter is a valuable, low cost instrument for both shack and shop. . . . W4WKM

Photo by: Morgan S. Gassman, Jr.

(W2NSD from page 6)

There have been many suggestions that the reason behind this move for incentive licensing is to cut down the number of phone stations and thus cut down on the QRM on "Class A" bands. If this is a factor in the mind of the ARRL directors then they should come out and state it. I seriously doubt that this can be so for this would be an unspeakable arrogance and manifestly unfair to the General Class licensees.

The June issue of QST reported on the meeting of the Board of Directors. Fascinating. Sandwiched in among many obvious platitudes we again find incentive licensing, this time invoked in the name of more efficient use of amateur frequencies, increased technical proficiency and more effective performance in the public interest, convenience and necessity. It is virtually impossible to be critical (even for me) of many of the points made by the directors. Some of them I have suggested in my past editorials, such as #7, the publication of League history, #4, a more effective Official Observer program, and #8, to encourage the amateur to make the best use of the presently allocated bands.

Frankly I was rather disappointed to see CQ taking a me-too stand on this subject, though I was not overly surprised, for after several serious cases of foot-in-mouth disease they seem to have turned extremely cautious.

What would be the effect if all of the General and Conditional Class licensees were suddenly demoted? I hate to think what this might do to the used ham equipment market! With tens of thousands of amateurs thrown off the bands that they have been using for many years and no longer able to keep in touch with their many friends, I suspect that we might well lose up to 50,000 amateurs. Maybe a lot more. Complicating the problem would be the anger that the deposed amateurs would feel over this inequity which might go a long way towards stopping them from just resigning themselves to fate and getting out their books for some more memorizing and studying. If only 10,000 amateurs dumped their equipment on the market it would have a catastrophic effect. It would take years before dealers could recover from this disaster . . . and we might well lose many of our present ham manufacturers. As one prominent manufacturer told me: "The ARRL is trying to put me out of business and I am casting my vote the only way I can; you'll see a lot more of my advertising dollars in 73." And this is from one of the most level-headed men in the industry.

It is not possible to roll back the clock to the Class A days for conditions are entirely different now. The old Class B license was primarily for fellows interested in CW operation, and in the old days the great percentage of the active amateurs were CW men . . . many didn't even have a mike in the shack. Today there are few amateur stations that are not equipped for phone and phone operation now dwarfs CW. In the old days the Class B amateur had the 160 meter band, 250 kc of phone frequencies which served about the same purpose as the present 75 meter band. Today we have a little skeleton of the 160M band left which would sink almost instantly out of sight with even a fraction of the old activity we used to see on the band. Where would the Generals have to go? To 40 meters? Ho ho. To 15 meters? 15, 10, 6 and 2 meters will all be pretty much the same for the next few years. These bands are fine for volunteer work, but just imagine being forced to operate there! This would make the General Class license about equal to the Tech license.

The ARRL has decided that amateurs should spend more time learning electronics and since the amateurs haven't done this by themselves they should be forced by government regulation to so learn. What has happened to the American way? Are we to follow the Soviet Union into complete government regulation of everything, even our hobby? Has the American way of doing things failed us completely? Is it possible that only government regulation is left as a method of getting fellows to learn more theory? Balderdash. Our readers survey polls show that the 73 staff technical series has a very high percentage of readership and interest. 73 readers *are* learning. In the 25 years that I have been reading QST I have never

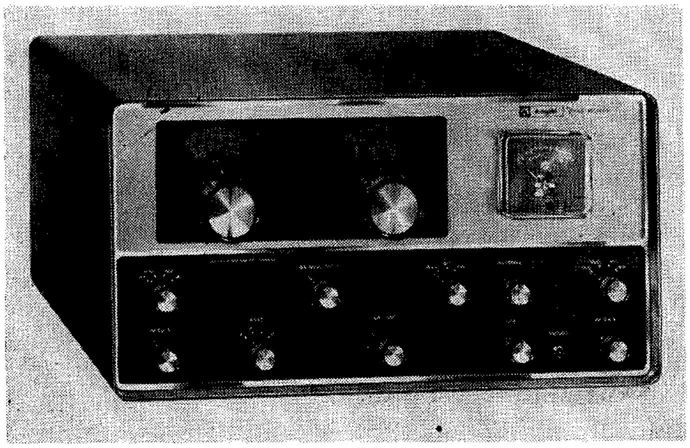
seen anything like our simplified technical series in the magazine . . . nor in the Handbook. Perhaps government regulation can substitute for good writing.

Another point. The ARRL makes a big point about how valuable incentive licensing was in the past. I might remind the Directors that in those days virtually every amateur built his own transmitter and as a result technical proficiency was strongly correlated with signal quality. It *was* a lot more complicated to put out a good phone signal than a CW signal and there was an advantage to requiring the phone men to pass an additional test on phone theory. Today, with the great bulk of the transmitters being commercially manufactured, it does not take any additional knowledge to operate phone (or even SSB). You just follow the instruction book and away you go. The signals on our phone bands will be exactly the same whether we require an additional exam for it or not.

Perhaps I'd better take this opportunity to speak up in behalf of commercial equipment. Strange thing for me to do since I am one of the leading proponents of home construction, eh? Let us hark back to the beginnings of commercial ham gear, the receiver. By the time I became seriously involved in ham radio almost every amateur was using a commercially made receiver. The transmitters were home made, but not the receivers. How come? Simple . . . receivers were too complicated for the average home builder to tackle, but transmitters were very easy to build. Doesn't the same rationalization hold today? Transmitters are now even more complicated than receivers used to be. How many stalwart constructors would tackle a 32S1 or any of the other sideband rigs today? Darned few. When I look into my 200V I see the virtual impossibility of my ever building such a device. Given a year of free time and unlimited machine shop facilities I suppose I could come up with something relay rack size that would do the same job.

Does this mean that home building should stop? Not a bit of it. There are still thousands of things that can be much better made at home . . . and a lot of things that will never be available any other way. The VHF men have to do a lot of their own work because there isn't enough demand for the commercial manufacturer to spend the thousands of dollars necessary to produce something for this limited market. Ditto RTTY, amateur television . . . etc.

(Turn to page 82)



Don Wherry W6EUM

A Ham Looks at the Knight Kit R-100A

and likes it

A recent survey of the stations being contacted here at W6EUM revealed that well over 50% were using some form of a kit transmitter. The same stations, meanwhile, indicated that less than 1% of them were using kit receivers. A little investigation into this situation uncovered a rather widespread belief that the assembly of such a receiver would leave something to be desired in the way of results.

Now if you are one of the more fortunate ones who can tap the family budget for $500 for a new super-delux job the validity of this belief is of little concern, however if you're like most of us where even $100 bends the monthly balance, perhaps you should examine the situation a little more closely. With this in mind, and since I am one who believes that a receiver kit costing less than $100 would be inadequate (some will argue that), a search was made into available units costing around that figure. The results of this search was the purchase of a Knight Receiver Kit Model R-100A and the following article is a review of this kit as a ham sees it, and not necessarily as the Knight Company might.

If you have not assembled, or seen, a modern ham kit in recent years you're in for a surprise when you unpack your R-100A. In contrast to what you may have heard or to what you may have remembered of early kits you will find the components of this unit to be of first class quality throughout—the chassis is heavy gauge steel, the tubes RCA, all resistors and condensers top quality and, in fact, no indication at all that Knight cut cost corners on components or hardware. Everything is furnished, even the solder.

Now for the assembly—the mechanical portion proved easy, being straight forward with no tricky adjustments or hard to get at parts or screws. The wiring itself is almost all printed circuit boards—only three of the fifty resistors used are not on these boards. This simplifies the wiring to an enormous degree and allows anyone, regardless of radio experience, to do the job. The resistors themselves are even mounted on cardboard with their "R" identification number alongside so you can even be color blind and still get the correct value.

The circuit itself is a nine tube (performing the function of 13) single conversion general coverage superhetrodyne. It's a fairly standard circuit starting with a 6BZ6 rf stage using four rf coils—the 14, 21 and 28 mc bands are all on one rf coil. There is an rf trimmer condenser controlled from the front panel which is used to trim the rf coil in use. This allows peak performance from the stage for any antenna loading, which is especially desirable from the ham operators standpoint.

The mixer stage uses a 6HB6, the pentode section of which is used for the mixer and the triode section for the conversion oscillator. There is nothing special about this circuit except, possibly, for the use of an OB2 regulator tube for the oscillator plate supply—nothing

else is on this regulator tube.

One thing about the circuit so far which does deserve mention is the band switch. This switch is a printed circuit board type and is the greatest thing invented since suspenders. It simply plugs into the main board and is soldered in place—36 connections made in approximately two minutes with no possibility of a mistake. The two *if* stages use the pentode section of two 6AZ8 tubes and are nothing unusual. The demodulator (detector) uses one section of a triple diode 6BC7 in a typical diode detector circuit. The second diode of this tube is a AVC rectifier which has a built in delay to remove all AVC action on weak signals. The third section is a series noise limiter which automatically adjusts itself for the average level of the received signal. This works real well for ham use. The two stage audio section is entirely normal and needs no comment. The BFO uses the triode section of a 6AW8 and is unusual in that the BFO output signal is fed into the circuit at the input to the second *if* stage, and there at a very low level. This seems to allow better operation on SSB and, when this feature is combined with the real smooth vernier action of the BFO frequency control, it allows excellent SSB reception. This from what is normally considered an AM detector—SSB is AM by the way. A product detector would probably operate a little better but this circuit does do a good job.

The Q multiplier is really something. Some multipliers of this type seem to be unstable and hard to operate when used in the "peak" mode, but this receiver seems to have licked the problems and its use makes a world of difference when you are trying to beat some bad QRM—and who isn't? Fact is if you have never operated one of these little jobs you will be amazed at the way you can pull a signal out from a big pileup of QRM. It's also valuable as a null device but, in my opinion, it is not as fine a performer there as a notch filter. Nothing else about the circuit is unusual enough to mention except that the power supply filter uses an LC combination instead of the more common RC, with the result that there is no discernible hum at all in the output.

A check on the sensitivity indicated that the specifications were reasonably close. However you must expect to do an alignment job to get real good results. Knight has complete alignment instructions and even suggests a way to do the job without a signal generator. However I would strongly recommend the use of a good rf signal generator. The coils are all pre-aligned but, that is not good enough if you want top results. The AVC does not operate on CW or SSB. This, in my opinion, is not especially important and only means that you must use the rf gain control for a volume control when in those modes.

The overall construction of this kit was so straight-forward and easy that no special instructions to you, as the builder, seem necessary. Just the usual caution to "do it their way." Use the manual and follow directions and you can't go wrong. The only trouble you might experience is in the identification of some things such as switches, controls, etc., and even there you will find, somewhere on the pictorials, the information you want.

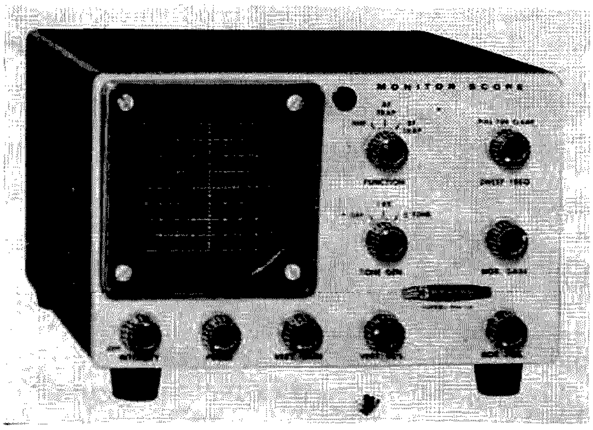
Now for a few general comments on this little job. The rig is much better looking than the pictures would indicate, the combination of jet black, silver and gray is real nice. When used with its matching transmitter it makes a very nice looking station. I do think, however, that the average ham will deplore the fact that it is not a "hambands only" receiver. While the bandspread feature spreads the bands over approximately 165 degrees of the bandspread dial, the markings are not especially easy to read. They look a little crowded. Also the bandspread dial has a ratio of about six to one in reduction and that also would be better if it were 12 or 15 to one. It's not hard to tune as is, but any help along that line is desirable. Maybe if enough of you would write Knight they would put out a ham band only model of this same receiver where a better dial and tuning ratio could be used.

Since this is a general coverage type receiver you should purchase the 100 kc calibration accessory, which is available quite reasonably. This I feel is important and just might save you a pink ticket. The S meter accessory makes the outfit look much nicer but adds nothing to the actual operation.

There is no more than the normal amount of drift in the conversion oscillator as it warms up, and after a few minutes this settles down well. No drift in the BFO was noticeable. A remote connection is brought out on the rear of the chassis to silence the receiver while you are on transmit and it works well.

To summarize—I think that the only conclusion that can be drawn is—if you have several hundred dollars to spend, go ahead and buy a SX115 or the S-line, but if not, take a good look at this kit receiver. If you want a general coverage job I doubt if you can touch a better receiver for the $100 asked.

. . . W6EUM



Roy Pafenberg W4WKM
John Bowden W4SYJ

73 Tests The Heath HO-10

The Heath HO-10 Monitor Scope is a welcome addition to the ever-expanding variety of amateur equipment available in kit form. This compact little handful of instrument contains a full 3" tube and is packed with all the features required for adequate monitoring and detailed analysis of both transmitted and received signals. The price of this unit, $59.95 in kit form, is remarkably low for the features provided. Ready availability of this instrument, at a price most amateurs can afford, should do much toward cleaning up some of the signals that infest our crowded bands.

While the value of a scope in adjusting AM and SSB transmitters is well known to most amateurs, the instrument is not as widely used as it should be. There are several reasons for this. It is often difficult to justify the purchase of the relatively complex and expensive general purpose scope to perform the relatively simple functions required of a monitor scope. An outboard audio oscillator, or oscillators, is required for thorough testing. The resulting test lash-up is usually so complex that it is only used for initial testing and adjustment. The HO-10 Monitor Scope combines these specialized functions in a compact instrument that may be left permanently connected in the station wiring.

While the specifications show all the details, several features, some of which are not included in competitive products, are worthy of special mention. Two audio oscillators are provided for both single frequency and 2-tone test of the transmitter. A full-fledged, adjustable frequency, horizontal sweep generator is provided along with both horizontal and vertical deflection amplifiers. Provision of a demodulator for rf trapezoid measurements, an rf attenuator and a beam clamp circuit are other design highlights. While these features are impressive, the true utility of the instrument is achieved by a switching system that functionally integrates them to best meet the specialized requirements of amateur station monitor service.

All inputs appear on the rear of the instrument and it may be permanently connected for the type of display desired in normal oper-

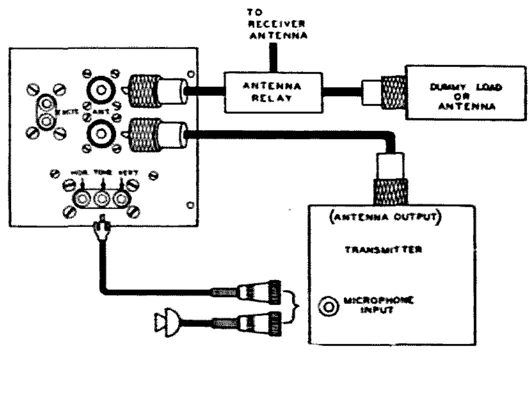


Figure 2

This drawing shows the proper connections for obtaining transmit envelope patterns. Typical patterns for various transmitter conditions are shown in patterns 1 through 21.

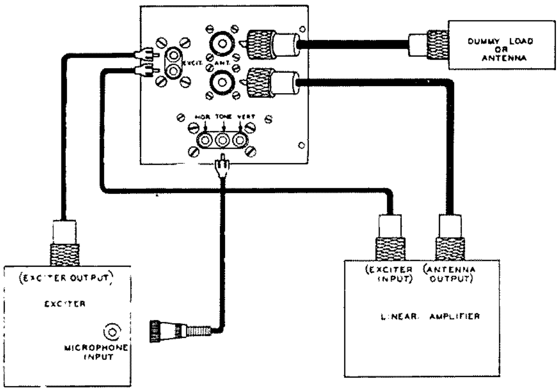


Figure 3

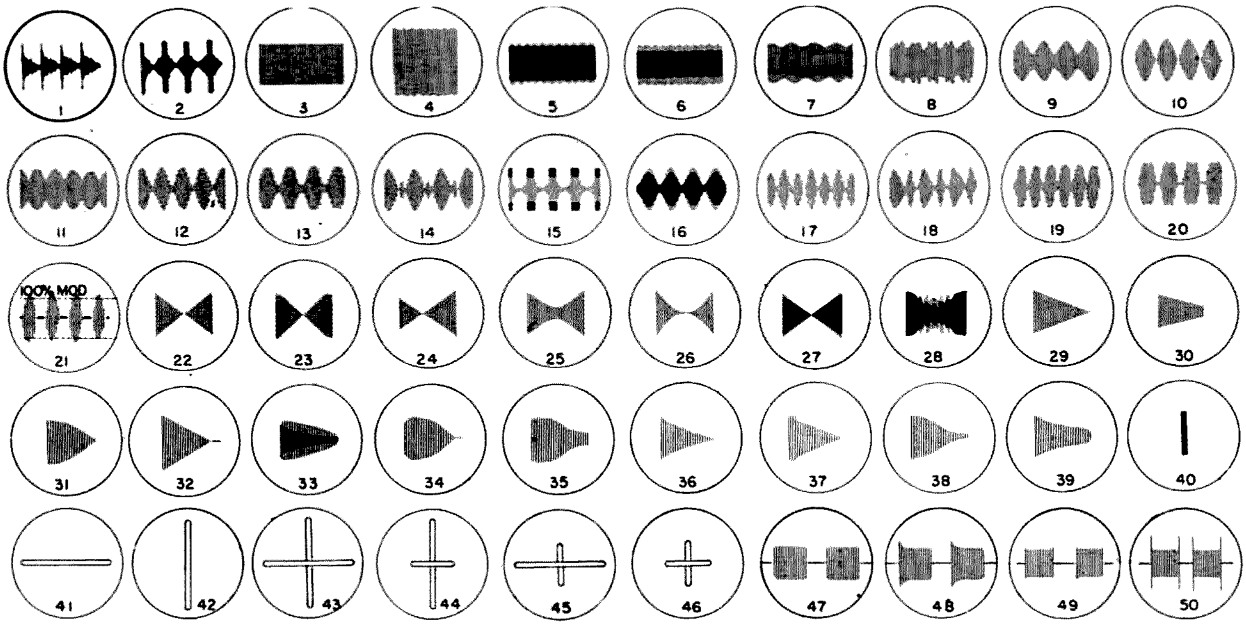
This connection is used to obtain RF trapezoid patterns. In this test the input of a linear amplifier is compared with the output signal. Any departure from linear operation shows up in the patterns obtained. Examples of various amplifier conditions are shown in the TRAPEZOID AND BOW TIE PATTERNS section. It should be noted that this connection indicates the operating conditions of the amplifier only.

ation of the station. Optional displays include rf enevlope, rf trapezoid and the more or less conventional trapezoid and bow tie patterns. Single frequency or 2-tone audio output is available for connection to the transmitter speech amplifier *during dummy load tests.* Switching between the transmitter and receiver displays is automatic. The transmitter is fed to one vertical deflection plate of the CRT and the receiver *if* to the other; normal transmit-receive switching disables one of the two inputs.

In use, the transmitter output coaxial line is routed through the HO-10 by means of two SO-239 connectors. A portion of the rf is coupled to the vertical deflection circuit of the CRT through a step attenuator which permits use with transmitter powers ranging from five watts to well above the legal limit. The input circuit is untuned and substantially independent of frequency to over 100 mc and is usable at higher frequencies.

In addition to use as a transmitter and receiver monitor, the HO-10, within the limitations of sweep frequency, makes a perfectly acceptable utility oscilloscope. While the instrument has many circuit features that would be of interest to the technically inclined reader, the specifications will have to tell the story. We are providing a special bonus feature in this article and space does not permit a lengthy discussion of circuit details or presentation of the HO-10 schematic diagram. Sufficient to say that the circuitry is more than adequate to meet all claims in the specifications.

Parts used in the HO-10 Monitor Scope were found to be of high quality. The mechanical



1) SSB signal, voice input, correctly adjusted. **2)** SSB signal, voice input, slightly excessive speech gain, or insufficient amplifier loading. **3)** Pure CW carrier or perfect single tone input on SSB. May also occur on single tone SSB with excessive drive which results in amplifier "flat topping." Note absence of fine ripple. **4)** SSB signal, single tone input, sideband suppression down approximately 40 db or CW signal with spurious radiation down approximately 40 db. **5)** Same as 4 except down approximately 20 db. In SSB, the poor suppression may be due to audio unbalance or improper RF phase shift. **6)** Same as 4 down approximately 10 db. **7)** SSB signal, single tone input with carrier leakage. This pattern will have half the number of ripples due to poor sideband suppression. (See waveform 5.) **8)** SSB signal, single tone input. Distortion in audio oscillator or audio system, balanced modulator detuned, or insufficient RF in balanced modulator. **9)** SSB signal, single tone input. Very little sideband suppression. Caused by defective modulator tube; audio phase shift network; 90 degrees RF phase shift component; partially shorted modulation transformer; secondary of transformer that feeds audio phase shift network shorted to ground; crystal oscillating on two adjacent frequencies simultaneously or both heterodyne oscillators on together. **10)** Normal double sideband, single tone input. SSB signal, single tone input with no sideband suppression. May be due to one modulator tube dead, modulation transformer open or shorted, defective bandpass filter. Normal SSB signal, two tone input, tones properly adjusted for equal amplitude. **11)** SSB with carrier, single tone input. Incorrect value of carrier or modulation. Excessively rounded tops would indicate too much carrier. **12)** Plate modulated AM, or double sideband with carrier inserted, single tone input. Nearly 100% modulated. Excellent waveform. **13)** Double sideband with carrier inserted (low level AM), single tone input. Too much carrier inserted. Note that the positive peaks flatten before a fine base line is obtained. Peak flattening may also be caused by insufficient antenna loading, insufficient interstage loading, an overdriven linear amplifier, poor dynamic power supply regulation, etc. **14)** Double sideband with carrier inserted (low level AM), single tone input. Insufficient carrier insertion or excessive audio, resulting in high distortion (overmodulated). Also called Double Sideband Reduced Carrier (DSRC). **15 & 16)** Low or high level AM with strong parasitics appearing on modulation peaks. Very fine, "Grassy" appearance on peaks would indicate parasitic in the UHF range. **17)** SSB, two tone input, or double sideband, single tone input; carrier leakage in either causes uneven height of successive half cycles of modulation envelope. **18)** Low or high level AM, single tone input. Severe distortion in modulator system or AF tone generator, RF feedback to audio system, or RF feedback to previous low level stage. **19)** Nonlinearity in modulated RF stage, single tone input, due to insufficient excitation of a plate modulated stage, overdrive to a grid modulated stage, or insufficient antenna loading of a grid modulated stage. **20)** Plate modulated AM, single tone input. Overdriven modulator incapable of 100% modulation. May also result from deliberately "clipped" audio not properly filtered. **21)** Plate modulated AM, single tone input. Modulator output more than ample. Modulation in excess of 100% in both directions. **22)** Good linearity. Desired pattern. **23)** Peaks slightly flattened. Caused by overdrive (grid current curvature), insufficient antenna loading, or regeneration. **24)** Carrier leakage through working modulator. **25)** Carrier leakage through disabled modulator. **26)** Grid bias curvature. Caused by excessive bias, or by operating some types of tubes with high plate voltage and high bias. May also be due to regeneration, or imperfect neutralization. **27)** Spurious radiation about 20 db down or insufficient selectivity in RF circuits, allowing undesirable beat products to pass through. **28)** Parasitic oscillation. **29)** Plate modulation, single or double sideband with carrier, or RF trapezoid. Good linearity. Desirable pattern. **30)** Plate, grid or cathode modulation; double sideband or SSB with carrier. Modulation less than 100%. No distortion. **31)** Nonlinear. With plate modulation, indicates lack of grid drive or insufficient grid bias. With grid modulation, SSB or DSB with carrier, or RF trapezoid through linear amplifier, indicates overdrive, insufficient antenna loading, grid cur-

rent curvature or regeneration. **32)** Plate modulation in excess of 100% in downward direction. Both modulator and final show good modulation capability. **33)** Plate modulation. Audio phase shift due to improper audio connection. Modulated approximately 80%. **34)** Plate modulation. Overmodulation in downward direction, with insufficient modulator capability. **35)** Plate modulation. Inadequate or mismatched modulator. **36)** Nonlinear. With plate modulation this indicates regeneration due to improper neutralization. In linear operaton this also indicates regeneration, or excessive grid bias. **37)** Parasitics occurring on modulation peaks. **38)** Screen grid or suppressor grid modulation, maximum modulation capability. **39)** Grid modulation with improper neutralization and reactive load. **40)** Unmodulated carrier. Can be caused by: No signal at horizontal deflection plates. Tone test oscillator inoperative. Gain control turned off on transmitter or oscilloscope. Audio failure in transmitter. **41)** Mark only. The relative narrowness of the elipse provides good indication of the channel separation capability in the terminal unit. **42)** Space only. The relative narrowness of the elipse provides good indication of the channel separation capability in the terminal unit. **43)** RTTY signal, proper shift, correctly tuned in. **44)** Incorrect shift, space tuned in. **45)** Incorrect shift, mark tuned in. **46)** "Straddle" tuning of incorrect shift. **47)** Good CW pattern, properly shaped keying, string of dots. Pattern can be approximately "locked" using automatic keyer or bug. **48)** CW pattern showing effect of receiver AVC action or poor power supply regulation in the transmitter. **49)** CW pattern, mild key clicks. **50)** CW pattern, severe key clicks.

assembly of the kit consists of a wrap-around frame with a chassis plate monuted vertically in the frame. This assembly is then secured to the formed aluminum panel. The chassis material is fairly light guage aluminum with a gold anodized finish. Despite the lightness of the material used, a very sturdy assembly results when it is all screwed together. As shown in the photograph, the substantial CRT bezel, attractive (and functional) CRT grid scale and the two-tone finish all combine to make a very attractive package.

The instruction manual is very comprehensive, consisting of 60 pages, 8½"x11", with 19 major assembly drawings and countless other drawings showing components, assembly details, equipment interconnection and typical scope patterns. The detailed, step-by-step assembly instructions were followed to the letter. No errors of any kind were found in the manual and no problems encountered in the construction. After construction, the scope was tested, following the instructions, and everything checked out perfectly. Assembly time, from start through final test, was just under 12 hours.

The design concepts and performance objectives for the HO-10 Monitor Scope were quite

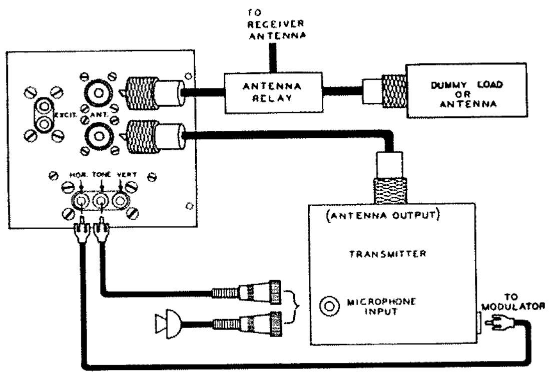


Figure 4

Test connections for obtaining the classic trapezoid and bow tie patterns. Typical patterns for various transmitter conditions are shown in patterns 22 through 40.

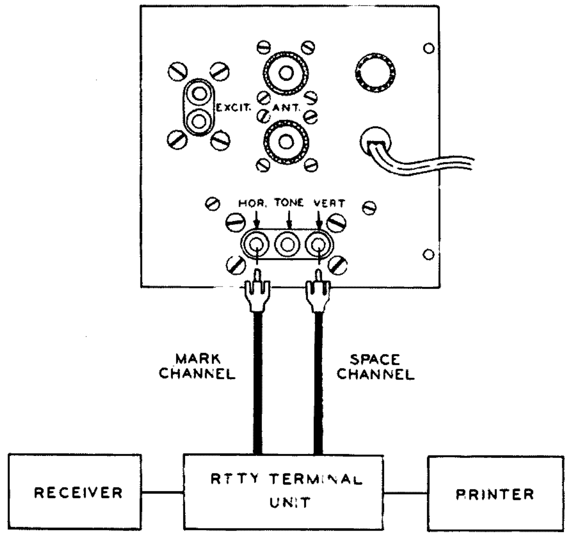


Figure 5

Test connections for obtaining RTTY cross patterns. This connection is useful in evaluating both converter performance and received signal characteristics. Typical displays are shown in patterns 41 through 46.

ambitious for a moderately priced kit. Heath is to be commended for the manner in which the production instrument achieves these objectives. Three amateurs have participated in this test and we all have nothing but praise for the scope. Heath is also to be commended on the instruction manual which should enable even the inexperienced amateur to construct the scope and, more important, use it to the best advantage of all who use our bands.

A full 19 pages of the manual are devoted to operation, interconnection of the instrument with station equipment and typical scope patterns. This is the most comprehensive collection of diagnosed scope pattern drawings the writers have found in any single reference. These drawings are of such obvious value and general interest that our immediate reaction was to call the Editor to see if he would agree to devoting the space for their reproduction as a part of a review article. Wayne's reaction was enthusiastic. The next step was to obtain Heath's permission for reproduction and here they are. Figures 2 through 5 show typical installations of the monitor scope. The captions indicate the type of displays that will be obtained. The actual waveforms depict operating conditions ranging from wonderful to horrible and, where appropriate, suggested corrective action is indicated. W4WKM

SPECIFICATIONS

VERTICAL AMPLIFIER—Frequency Response: ±3 db from 10 cps to 500 kc. Sensitivity: 500 mv per inch deflection. Input Resistance: 50 KΩ.

HORIZONTAL AMPLIFIER—Frequency Response: ±3 db from 3 cps to 30 kc. Sensitivity: 800 mv per inch deflection. Input Resistance: 1 megohm.

SWEEP GENERATOR—Recurrent Type: Linear sawtooth produced by internal sweep generator. Frequency: 15 to 200 cps (variable).

TONE OSCILLATORS—Frequencies: Approximately 1000 cps and 1700 cps. Output Voltage: 15 mv (nominal).

GENERAL—Frequency Coverage: 160 through 6 meters (50-75 Ω coaxial input). Power Limits (At rear coaxial connector): 5 watts to 1 kilowatt output. Tube And Diode Complement: 1—3RP1 CRT, medium persistence, green trace. 1—6BN8 Clamper, low level RF detector. 1—6C10 Sweep generator, horizontal amplier. 1—6J11 Twin phase shift tone generator. 1—12AU7 Vertical amplifier. 1—1V2 High voltage rectifier. 4—Silicon diodes, B+ rectifiers. Front Panel Controls: FUNCTION Selector. SWEEP FREQ. TONE GEN. HOR. GAIN. HOR. POS. VERT. POS. VERT. GAIN. FOCUS. INTENSITY/OFF. Rear Control: XMTR ATTEN. Attenuates 0 to 24 db at approximately 6 db per step. Power Supply: Transformer operated, fused at ½ ampere. Power Requirements: 105-125 VAC, 50/60 cps, 35 watts. Dimensions: 5¼" high 7⅜" wide x 11" deep (including knobs). Net Weight: 8¼ lbs. Shipping Weight: 10 lbs.

(W2NSD from page 75)

To sum it up. I cannot see that the ARRL has proved that there are any advantages to their proposed incentive licensing plan, nor have I yet seen any indication that they are speaking for their members in this move.

Club News Bulletin

Now that we have bulletin printing facilities at the 73 Hq we can renew the publication of the Club News Bulletin which was so popular.

This bulletin comes out monthly and is designed to be of help to the editors of club bulletins and to provide news of interest to club officers. The editor, Marvin Lipton VE3-DQX, scans all of the club bulletins each month and exerpts the news of interest for other editors to use. He also passes along lots of information of great value to club officers

who are anxious to keep their clubs in top shape.

The subscription to the Club News is only one dollar per year. Send your dollar to VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada and be sure to put Marvin on the mailing list for your clubs bulletin.

If your club officers might have missed this announcement we would appreciate it if you would read this at your next club meeting and get the club to allocate the dollar.

NEW VHF MAGAZINE
$2.00 a year!

One of the big problems with VHF news is that it is usually old before you can get it. The publishing schedules of all ham magazines prohibit anything current ever being rushed into print. About the fastest news you can manage under normal publishing conditions is 30 days, with 45 to 60 days being the rule. This is one of the big reasons why we have never considered running a VHF column in 73.

The obvious solution to the problem is to publish an offset magazine which only takes a day or two to be printed and mailed. This is what DX Magazine is doing and they are doing it well. In the DX field you know about DXpeditions and new stations while they are still on the air instead of after it is too late to do anything about it.

In order to cope with this difficult problem we have wangled our naive bank into enough of a loan to buy a small offset press. We've also installed one of those six foot copy cameras for making our own negatives, a dark room for processing them and all of the graphic arts facilities necessary to prepare material for printing as fast as possible. Never has a VHF magazine had such facilities for quick publications.

The Post Office is a stumbling block. If we send the magazine out by the usual second or third class mail it will be a week or so old before you receive it. We'll try using first class mail. The first one thousand subscribers to VHF (original name, wot?) will get first class mail delivery of the VHF magazine at no extra charge. If we find that we actually can break even doing this we will continue it, otherwise we will have to use third class mail for later subscribers and increase the subscription rate just a bit for those who are anxious for immediate delivery.

We have been very fortunate in getting a highly experienced editor for VHF magazine:

(next page, of course)

Jim Kyle K5JKX, who is both an avid VHF'er and a marvelous writer. Jim is looking for volunteers to help him with this project. He'd like to have fellows who are active in different areas keep him up to date on activities, openings, new developments, and anything else that will be of interest to the VHF'er.

Send $2.00 to VHF Magazine, Peterborough, New Hampshire. Include name, call, and address.

Certificates

Now that we have complete printing facilities here at 73 for making things like subscription blanks, etc., we find we are all set up to turn out certificates. If your club has a certificate in mind and you have any problem getting it made up by a local printer we can do a nice job for you at a very reasonable price. Just send in a sketch of the layout you want, typewritten copy of the wording, good inked drawings for any artwork, and we will be able to take it from there. Our art department can make up the finished layout, make the negative of it, and from that we will make up a printing plate and print your certificates. The price for this is $25 for 500, $20 for 250, and $15 for 100.

Manufacturers Please Note

By way of doing something special in our October issue we will run a special section devoted to covering, as completely as possible, the equipment in current manufacture this fall. I would appreciate getting as complete specifications as possible, including a good glossy photograph, at an early date. We will be devoting special sections to transmitters, receivers, transceivers, linears, and VHF equipment.

And Readers

The October issue, celebrating the start of our fourth year of publishing, will be our first with a four color cover. One of the major difficulties in running a full color cover is in getting photographs that are worthy of the enormous printing expense involved. If you have any ham radio pictures in full color which are technically excellent why not submit them for possible cover use. We'll pay well for them.

License Fees

An awful lot of fellows are probably hoping to open 73 this month and find me blasting the FCC for being so rotten as to set up license fees for ham radio. Unfortunately, as I have written before, the fee seems entirely reasonable to me.

Though I am not completely immune to the something-for-nothing virus, I have a better than average ability to fight off its ravages. Things just don't seem worth much unless I have to work for them.

While I realize that my skills as a ham are of value to the country, I cannot accept that they should pay for them unless they set up a system to evaluate the extent of my skills and pay me what I am worth . . . and everyone else what they are worth. This is obviously impossible, so why not strike that flimsy rationalization for getting our ham license for free. And how about all the public service I accomplish with my license, like the time a group of people were trapped on top of Mount Washington and the only communication was through my Gonset Communicator. Same argument . . . I was happy to do it and enjoyed it, and that is the basic reason for a hobby, isn't it? Why should I get paid for having fun?

We have, it seems to me, been getting something for nothing for a long time now and I'm greatly encouraged to see it stop. The FCC gives me quite a lot: a license exam, all the paperwork necessary to issue me a license, allocated frequencies (and you wouldn't even believe all of the work that goes into this), monitoring to clear up some of the inconsiderateness of other amateurs, plus an interest in changing the rules to keep up with progress. I'm getting a very good deal.

If I, personally, am getting all this benefit, is it fair that I shouldn't pay for it? Why should public tax money be taken for my personal benefit? I know how I feel about the government draining off my dollars with taxes at every turn in order to support things like foreign aid (give them the money, but don't let us go over and visit and spend money for something in return, thereby developing their economy instead of riddling it with graft brought on by our handouts), social security (take 46c dollars from me now and give me 10c dollarettes when I am 65), federal price supports (I have to pay more for things), etc.

Perhaps when fellows have to pay a bit for their licenses they will take a little more interest in their hobby. One of the greatest things that could ever happen to amateur radio would be for a few hundred fellows to care enough about it to improve it.

The fee, by the way, is only $4 for a five year license for new and renewals. Modifications are $2.

Silver Lining

As if the CB'ers didn't have enough prob-

lems with the proposed amendments to their regulations which promise to practically put the ham-type CB operation out of business, now they have a little extra worry: a license fee of $8.00! What the revised regulations don't do it is probable that that fee will. It is entirely possible that we may see the eleven meter band eventually in use as was originally proposed by the FCC.

The CB magazines have reacted interestingly to this challenge. CB Horizons seems to be out to make the FCC back down by fighting the proposed changes in every way possible. I suspect that they realize that a great percentage of their readership is made up of ham-type CB'ers and that the existence of the magazine depends upon saving this type of operation. S-9, which seems to have met with considerably less success than CBH from what I can see, may have given up the ghost already for I've heard reports that they are planning consolidation with CQ, which would probably be for the purpose of making good the few subscriptions that had been sold. No doubt this would mean that S-9 would follow VHF Amateur into the oblivion of the back pages of CQ, getting smaller and smaller each month. Good riddance S-9.

"I Already Subscribe to so many Magazines I Can't Read 'em All"

This is the story I hear at conventions over and over again. Somehow this plea falls on deaf ears, not because I am so intensely involved with the magazine that I can't appreciate other peoples problems, but because I know what a lie that is. Or perhaps I should be kind and use the word "rationalization," which is a more polite way of saying lie because it is a lie that you really believe.

Virginia and I got to talking about this the other day as we were driving up to the printer in Hanover (N.H.) to give the final OK's for the June issue. Virginia made a list of the magazines that I read and counted 94 magazines that I subscribe to and read each month. This is in addition to about 100 club bulletins, three or four books, The Wall Street Journal (I just skim that), and an unbelievable number of ad catalogs which come in each month. On top of that I put in about twelve hours a day on the magazine, I help cook (I like to cook) the meals, and even help wash the dishes now and then. I watch a few favorite TV shows (three or four a week in

(Turn page)

(W2NSD continued)

addition to Bullwinkle daily), devote some time to marvelling over the kid (named her Tully; after my Grandfather; family name), and greet an almost constant stream of salesmen interspersed with visiting hams.

If I can get all that reading done on my schedule I don't see why fellows begin to panic when they have three magazine subscriptions. There is always a pile of magazines that I have to wade through to get to bed . . . and Virginia has a pile on her side.

Of course I have to admit that a good number of these magazines are in the radio field: QST, VHFH, WRA, Electronics World, Poptronics, DX, Electronics Illustrated, Science & Mechanics, Short Wave, RSGB Bulletin, Broadcasting, Electronics Design News, Instrument & Apparatus News, Product Design, Japan Electrical Industry, Electronic News, CQ, S9, CBH, Radio Constructor, Autocall, Monitor and probably more that escape me at the moment. I have to keep up with the printing field too: Printers Ink, Graphic Arts, Printing News Weekly, In-Plant Offiset, and Printing Production.

Newsweek does well for me in the general news department, saving me from much reading of the daily papers. Life gets a cursory reading, as does the Post. In the car field I read Sports Car, Pit Talk, Porsche Panorama, Christophorus, Road & Track, International Autoist, Car & Driver, Motor Sports and bulletins from the various clubs I have joined.

Humor: Mad, Help, New Yorker, Monocle. Then there are miscellaneous magazines such as Skin Diver, Readers' Digest, Analog, Family Handyman, All Pets, Aquarium, Holiday, Fortune, National Review (weekly), National Review Bulletin (weekly), National Geographic, U.S. Camera, Modern Photography, Industrial Photography, Scientific American, Mensa Correspondent, Popular Mechanics, Changing Times, Consumer Reports, and the Village Voice (weekly).

Yes, I read them all . . . weekly or monthly. Now, about all those magazines which don't leave you time to read 73 . . . . . ?

Progress Report

One of the most often asked questions is, "How do you like it up in New Hampshire?" My answer is, "I wouldn't move back to New York for anything."

This 37 room old house that we are using for living and offices is ideal from almost every standpoint. It is beautiful and impresses visitors, which is nice. Though we are gradually filling it up, we haven't yet exhausted the accomodations. If I keep buying surplus gear we will run out of barn space one of these days.

The one drawback to the house is its location right on Route 101. This furnishes us with a miserable noise level on the VHF bands much of the time. We looked around for something similar to this house, but with a better location. We found a nice one up on top of a hill not far away . . . several hundred feet higher than we are now. This really looked good from a VHF viewpoint and we even began to consider the possibility of putting in a regular broadcast FM station up there too. But the house, as large as it was, didn't have a barn and this meant that we would have to build storage facilities and probably even some extra office space. It was wonderfully isolated, being more than a half mile from the nearest house.

There was a little additional problem . . . we still didn't have any money. Fortunately the bank was willing to overlook this and they worked out an interesting arrangement which provided us with the house 100% financed!

Every time I went up and looked over the new place I got a little more discouraged about all of the building that we would have to do. Finally I decided that, even with a half dozen eager beaver hams to help us this summer, we wouldn't be able to get all the extra space built that we needed by fall. I dropped a hint to our Porsche-pushing real estate broker that I might be induced to sell and a few days later the place had new owners and we had a nice little bundle to help out the magazine.

Virginia began to get all excited, thinking of trips for 2¼ around the world, until she realized that what looked like a fortune was in fact about equal to about one week's expenses of the magazine. Instead of being nip and tuck, usually on the nip side, we were suddenly a week ahead. Big deal.

I'm Not Complaining

There is nothing like living in the country to give a girl a chance to make up for an underprivileged (animalwise) city childhood. While I have been pursuing bigger and better two meter antennas (making up for *my* underpriviledged city childhood) Virginia has been quietly adding to the animal population around here. New Hampshire puts out the devil's own invention: the Weekly Market Bulletin. From this miserable little sheet we have so far picked up two goats ("aren't they cute"), two geese ("aren't they cute"), four ducks ("aren't they cute"), and two Dutch Rabbits ("aren't they cute").

That isn't all. One of the 95 magazines we subscribe to a month happens to be All Pets. From the ads in this insidious source come all sorts of Express packages. There were the tropical fish, complete with tanks, heaters, filters, and all that. You should see how easy it is for salt water tropicals to drop dead . . . unbelievable. Then came some white mice ("aren't they cute"), which were ordered as food for the Indigo snake (no mention of cuteness). I must admit that the snake is intriguing . . . and reasonably friendly . . . for a six footer. An article on what marvelous pets skunks make put us on the waiting list for one of those as soon as it is weaned. Another article on Burmese cats got one of those on the way.

Perhaps I'd better say something so things don't get out of hand.

. . . Wayne

Correction

Lazy Man's Coil Evaluator, June 1963

In Fig. 6 on P. 22 of June 73 the two resistors marked 100 should be marked 100K.

(Transformer from page 37)

preserved the original appearance of the rig. The 5U4GB rectifiers were removed and added to the junk box, and 6DE4 half wave TV damper rectifiers were plugged in.

The bridge rectifier could be 100 per cent silicon diodes, but the 6DE4's have the advantage, again, of preserving the (almost) original appearance, and secondly are slow-warm-up types which allow the rest of the tubes to come to operating temperature before the low B and final screen voltages are applied. The high B voltage will come up immediately to about 400 volts, and, as the 6DE4's warm up, to 800 volts (no load). Sarkes-Tarzain F-6 diodes were used to complete the bridge, with .0015 mfd ceramic disc capacitors across each one to divide up the inverse peak and ac transient voltages. Fig. 1 shows the original circuit, and Fig. 2 the modification. Note also that the 5 henry high voltage filter choke has been eliminated. This choke shorted causing the failure of the power transformer. A little pencil pushing showed that the ripple percentage without it was 4%. This was reduced below 1% (full load value) and the dynamic regulation improved by the addition of two 100 mfd 450 volt filter capacitors in series as

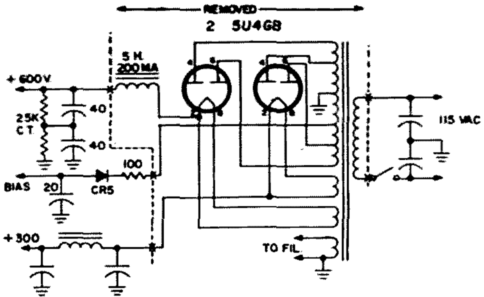


FIG 1

All components between dotted lines were removed. Showing the modified supply. D1 thru D6 are 750 ma 600 piv C1-C6 are .0015 mfd 1000v disc, C7 and C8 are 100 mfd 450v (Sprague TVA-1718). T1 is Merit P-2884 or equal, T2 Merit P-3046 or equal.

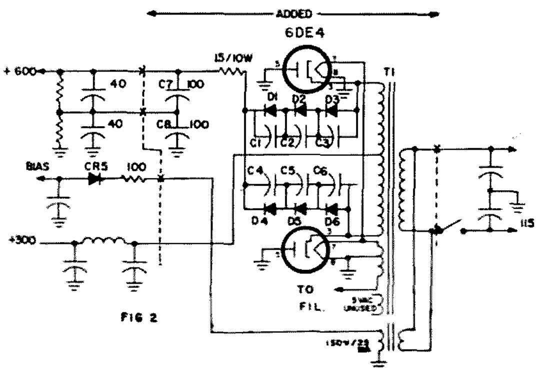


FIG 2

shown in Fig. 2. These capacitors were mounted in the space formerly occupied by the choke.

The center tap of the 12.6 volt winding was grounded, the 6.3 volt filaments of the transmitter were supplied from one end, and the other end supplied the 6.3 volts for the 6DE4's. The hardest part of the modification was moving all the filament leads from pin 5 of one of the rectifier sockets, formerly used as a tie point, and now the plate of the 6DE4, to pin 6 of the same socket. The photos tell the rest of the story. . . . W5PPE

I'd like to see . . . answer

Dear Wayne,

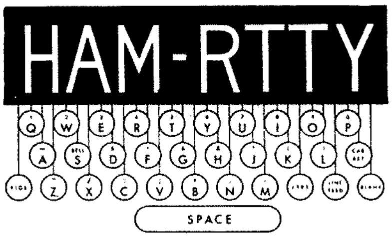
In reference to W2WLR's note (May page 55), the following are some of the coaxial cables that are available with silver plating of the inner conductor: RG's 5A, 9, 55, 87A, 94, 115, 141, 142, 143, 144, 159, 165, 166, 209, 210, 214, 223, 225, 226, 227 . . ./U. All have 50 ohms. RG5A/U and RG9/U are probably best suited for use by the ham fraternity, and I have seen them on the surplus market at relatively low cost.

Jim Fisk WA6BSO

73 Products

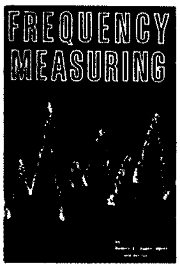
Peterborough, N. H.

NEW RTTY BOOK $2.00



This handbook is written for the beginning RTTY op, but due to the profusion of info, pictures, circuits, etc., it will be valuable to all RTTY'ers and those who may RTTY themselves. If you don't know what RTTY means don't buy it. For $2 what can you lose? It's worth almost that much in paper.

FREQUENCY MEASURING HANDBOOK $1.00

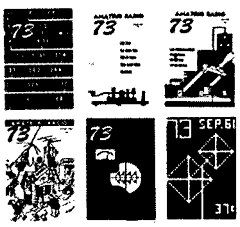


Rather thorough exploration of the subject, complete with an exhaustive bibliography. By WøHKF

BINDERS FOR 73 $3.00

Keep your issues of 73 all in good shape and keep them from straying. Specify year: '60-61, '62, '63. Red Leather binder with gold stamped "73" and year. Darbs.

BACK ISSUES 50c

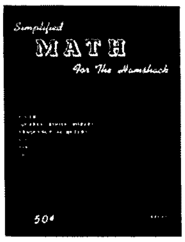


You can enjoy back issues of 73 just as much as current. Send for one each month to pad out those dreary days. All back issues now available except January 1961. Early issues going to $1 soon. Supply very limited.

CARE AND FEEDING OF HAM CLUBS $1.00

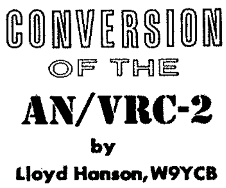
K9AMD's interesting book on all aspects of forming and holding together a ham club. This is the result of exhaustive interviews with many club officers and will be invaluable to every club going.

SIMPLIFIED MATH 50c



This booklet takes you gently by the hand and leads you through the mysteries of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc., and does it by an amazingly new method.

AN/VRC-2 CONVERSION $1.00



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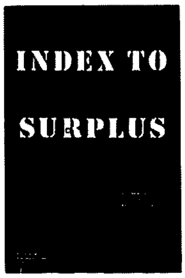

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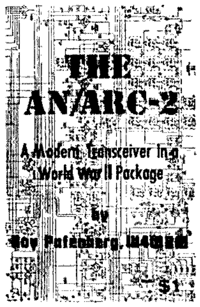

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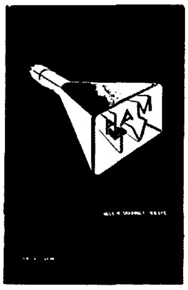

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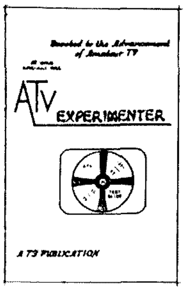

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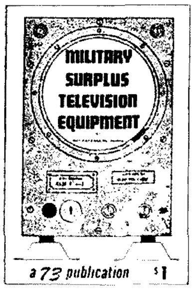

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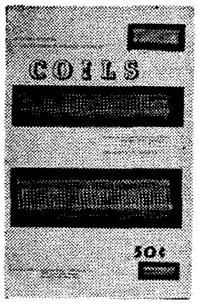

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Amateur Radio

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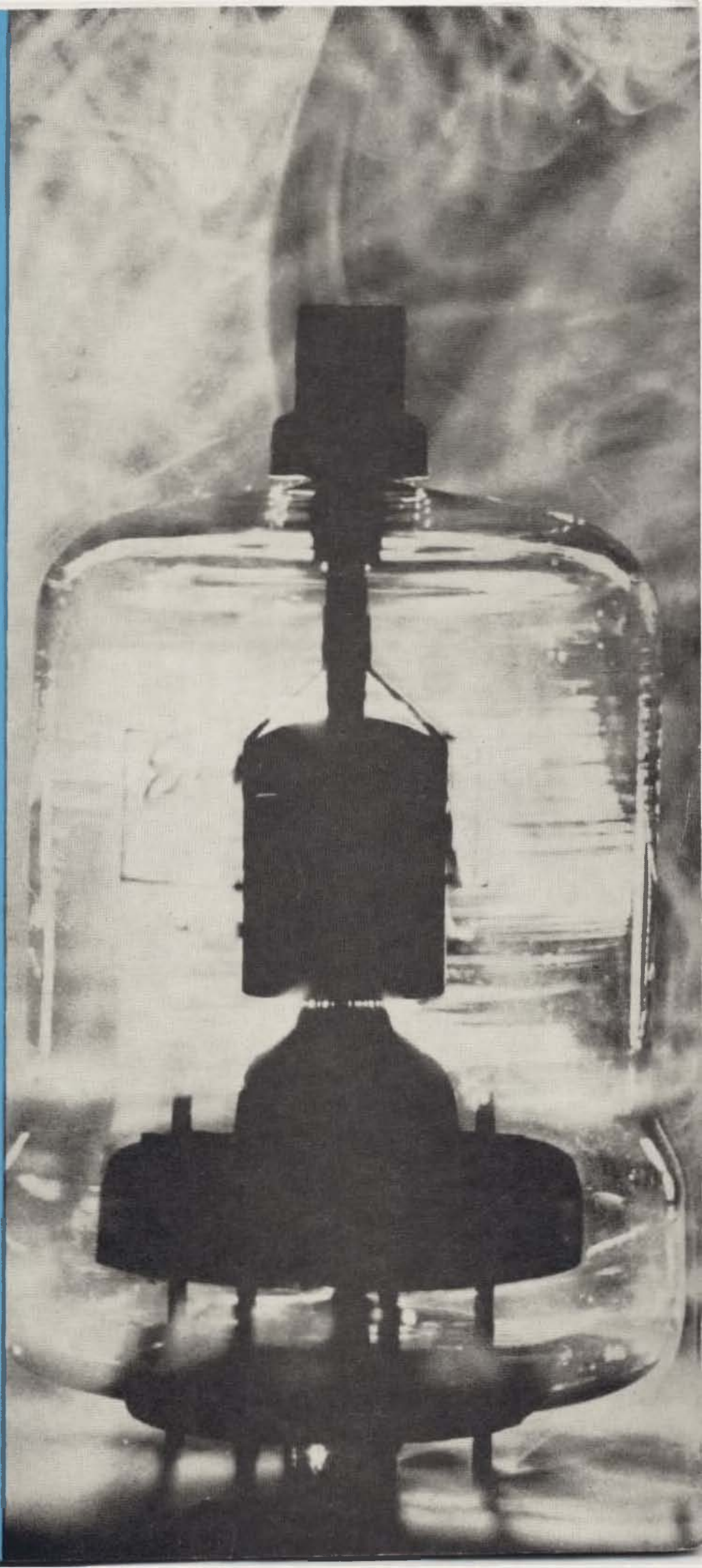


73

Magazine

Wishy-washy

Wayne Green W2NSD/1

Editor, etcetera

August, 1963

Vol. XIV, No. 8

Cover:
Photo by Paul Porcaro

73 Magazine is published monthly by 73, Inc., Peterborough, N. H. The phone number is 603-924-3873. Subscription rates are still abysmally low at $3.50 for one year, $6.50 for two years, and $9.00 for three years in North America and U.S. possessions. Foreign subscriptions are $4.00 per year. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in the U.S.A. Postmaster: please send form 3579 to 73 Magazine, Peterborough, New Hampshire. Over and over we tell you to stop prying into the fine print, just turn the page and get at the editorial.

Important! See page 65 for ballot on restricted phone bands.

de W2NSD

never say die

ARRL Policy

The July QST editorial has several rather momentous revelations for us all. If you are not a subscriber then you might take the time to read it while visiting one. The bulk of the editorial is occupied with an attempt to stem the obvious flood of critical mail they are receiving as a result of their pronouncement on incentive licensing. I suspect that the July editorial will only add fuel to the fire of thinking amateurs.

The most important revelation, and it is one that may shatter thousands of dream worlds all over the country, is their frank admission that the ARRL has no intention of representing its members and that this has been their policy in the past. They admit that they put little stock in polls (which no doubt explains the lack of them). They point out that they are representing the "best interests" of the amateurs and they admit that this has often been contrary to the wishes of the membership.

It is admittedly a lot simpler to run things dictatorially than it is democratically. Thus we have the picture of the ARRL Executive Committee and Board of Directors in a position to make the most earthshaking of decisions without consulting the membership. It seems to me that the best interests of the amateurs would be served by taking a page from our own government and attempting to have the Directors of the ARRL keep in closer touch with their constituents as do the U. S. Senators and Representatives. One basic for this is an enlightened constituentcy, which has been virtually impossible in the past because of economic pressures from ARRL members and advertisers who would not permit any criticism of the League. The slightest attempt at bringing hidden matters to light was met with cries of anti-ARRL. The fact that I believe that they are being very wrong in this matter of incentive licensing does not, I hope, make me anti-ARRL any more than my distress over the present state of the income tax, foreign aid, social security, etc., makes me anti-American.

To get back to the QST editorial, I notice that the FCC is brought into the matter in support of their position. Hmmm. Since it is the FCC that is actually running ham radio these days I suspect that if the FCC did have incentive licensing in mind that they would have done something about it directly. My not infrequent discussions with the FCC have not uncovered any enthusiasm for the ARRL plan.

How about the amateurs? What do they think? In my editorial last month I attempted to examine carefully and unemotionally the ARRL stand on incentive licensing. I expected to get the usual response from angry ARRL supporters who believe that anything the League does is right. Well, either angry ARRL'ers are slow writers or else they are a dying breed for not one has yet protested my evaluation of the situation.

On the contrary, hundreds of letters applauding the editorial have come in. I could devote the bulk of several issues of 73 to reprinting the more lucid of these letters.

ARRL, Pro and Con

I think it was about 1938 that I first joined the ARRL. Or perhaps it would be more accurate to say that I subscribed to QST and in the process received an ARRL membership certificate. QST was no more helpful then than it is today in letting a person know about what is going on within the ARRL, and the only other ham magazine, Radio, was equally silent, so I didn't know much about the internal workings of the hobby.

After the war, When I began to devote large lumps of my life to the hobby, DX'ing VHF'ing, RTTY'ing, etc., I began to take more interest in the ARRL. Having been, from the first, predominantly a phone operator, I soon began to sense a strong CW bias of the League, though I realized that this was quite natural since the basic reason for the League

(Turn to page 6)

W2NSD from page 2

to exist had to do with relaying messages, a process that was almost exclusively carried on via CW.

I watched with increasing interest as pressures built up for more adequate representation of the phone contingent of our hobby and saw this pressure result in the formation of the National Amateur Radio Council. With the opening of the forty meter phone band and an expansion of the seventy-five meter phone band the pressures were relieved and NARC gradually disappeared.

But the NARC left its mark behind, indelibly. Where before its existance the FCC had been rubber stamping the requests for amateur rule changes proposed by the ARRL, now there was a complete reversal. I suspect that the FCC was rather shocked to find that the ARRL had been pursuing its own ends and not, as billed, those of the amateur. The almost instant success of the NARC was proof to anyone that things weren't going right.

The FCC apparently thought the whole matter over and decided that if this is the way things were going, that they would be boss and run ham radio themselves. This spelled the end for the ARRL as a representative of amateur radio.

At this time in history I had become quite involved in RTTY and was publishing a monthly bulletin on the subject to some 2000 interested hams and had started a semi-monthly column in CQ. This brought me into contact with the then editor of CQ, Perry Ferrell, and I began for the first time to learn some of the things that had been going on in our hobby. It frankly was quite a shock.

The new FCC administration proceedures system must have been quite a bombshell to the ARRL. Where before they had been virtually running our hobby, suddenly they were completely rejected. I wondered what they would do about this monumental setback and watched QST with interest to see what would happen. For those of you who are not familiar with this ruling, it specifies that henceforward any individual amateur or group of amateurs who want to have the rules changed can petition the FCC directly for such rule change and that the FCC will consider all comments, pro and con, on the rule change and decide on the basis of the validity of the comments, whether they come from individuals of clubs. This put the ARRL on an equal basis with individual amateurs, giving them an edge only if they

Turn to page 80

Dry Cell Amateur Stations

for mountaineering, camping, and emergency

William Hoisington KICLL
83 Bellevue Avenue
Melrose 76, Massachusetts

Ever since 1923, when, in Rye, New York, as W2BAV, I operated from a rowboat loaded with large B batteries, no. 6 dry cells, a 201A regenerative receiver and a loop-modulated 201A transmitter on two hundred meters, the antenna strung between bamboo poles on each end of the boat, portable battery operation has held a great fascination for me.

The idea of two-way communication while walking, climbing, or camping, in the true sense of the word, has resulted in many varieties of battery rigs and walkie-talkies over the years. One of my most enjoyable periods of amateur radio occurred before World War II, on an island in Penobscot Bay, Maine, when, as W1LAS/I, I used 3 B batteries, some dry cells, a 30 "speech amplifier," a 33 modulator, a 30 oscillator, and a 33 final (all dry cell tubes) running about a watt on 160 meter phone, with a 270 foot high antenna and a salt water ground. Many of the locals that were contacted are now still on the air: W1IRQ in Castine, W1RPH in Deer Isle, now on 2 meters, among them.

Later, a new series of tubes came into use; the 1T4, the 1R4 being examples. These were good dry cell tubes, but restricted mainly to the BC and SW bands for good operation. Their utility fell off rapidly with increased frequency of the use of the VHF bands.

In the last few years, several features were developed at the same time providing for a considerable increase in the attractiveness of dry cell operation. 6 meter stations became more plentiful, good portable VHF dipoles and beams were made up, and good VHF subminature tubes came into use such as the 1AD4, 1AH4, 1AJ4, 1V6, and others. Surprisingly good portable double-conversion superhets could then be made at *low-cost*. Fig. 1 shows a 6 meter receiver circuit of this type.

For the rf stage you have a choice of the 1AD4 or the 1AH4. The 1AD4 has higher gain but costs more. The GM is around 2,000, while the 1AH4 rates about 900. Either small 30 to 50 mc iron cores may be used, for small overall size, or large air-wound coils, which will give higher Q and greater freedom from image, TV harmonics, etc.

A convenient way to build low-cost units is to use thin copper-clad bakelite for base boards. This is rigid enough to hold everything, yet solders at a touch of a small iron for all ground connections. Front panels, shields, trough-lines, and even boxes can be soldered together quickly with the copper-clad bakelite.

After the rf stage comes the mixer-oscillator. The 1V6 must be mentioned here. Just who designed this red-hot little dry-cell item is something I would like to know for sure. I think it was originally a Raytheon job. Maybe somebody will speak up. When the oscillator plate section is used as the tuned portion of the oscillator it is a very sensitive mixer, way up into the VHF band, with little "oscillator pulling" from the pentode signal grid circuit. By the way, use good capacitors in the oscillator section. I had one that shifted many kc every time I got out of the car and started to walk up a mountain in cold weather.

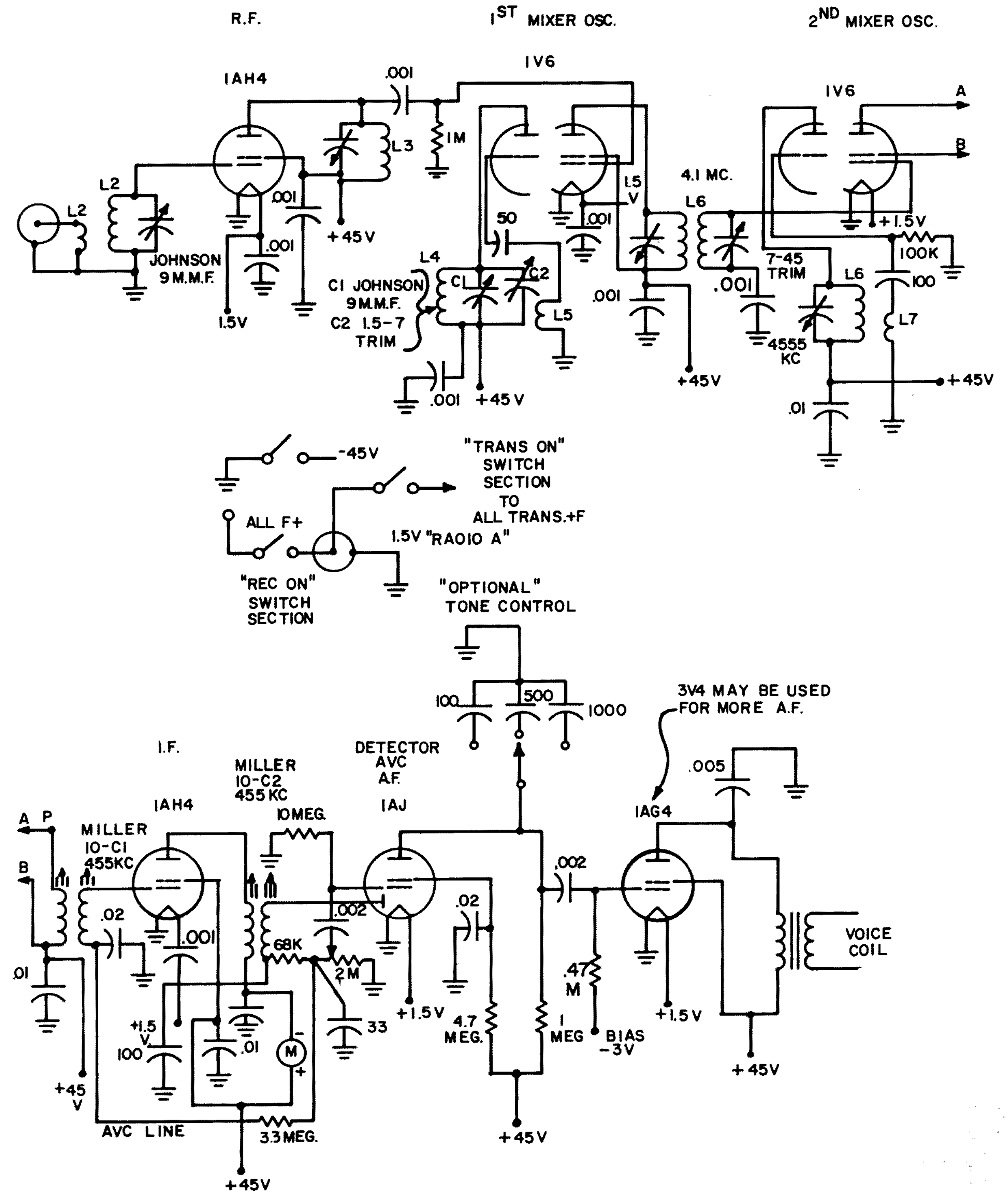
The 1V6 mixer plate can be fed directly into the miniature *if* transformer, or go through another mixer at 4 mc. The circuit of Fig. 1 shows this double conversion, as there is less oscillator pulling and greater freedom from image, with the oscillator 4 mc away from the rf signal. The additional gain doesn't do any harm either.

A 1AH4 is in the *if* stage. All the miniature *if* transformers (Miller 10-C1 and 10-C2) I have ever tried have all worked well. Be sure and get a *very* small insulated tuning screw-

driver in your local store, and try it on these *if* transformers *before* you leave.

The diode, af, and audio stages come right out of the tried and true RCA circuit handbook, and have also worked every time FB.

I word about dry cell *if* and af diagrams, and good down-to-earth economy circuits in general. Probably for simply good marketing reasons RCA has published excellent circuits on dry cell receivers, at least for the broadcast and SW bands. When you get up in the 28-50 mc region, that is another story. The low-cost RCA tube handbooks have very good *if*, detector, and af circuits for the dry-cell tubes



L1 8T wide spaced #28 ¼OD
L2 9T 16/inch air wound
L3 8T 16/inch air wound
L4 6T 16/inch air wound
L5 3T wound on L4 #28 insulated
L6 64T 32/inch air wound
L7 64T 32/inch air wound
(L6 and L7 Miller #6203 4.5 mc if T)

mentioned here but a few changes for the better can *still* be added. Fixed bias on the grid return of the 3V4 audio is one of these. This is a *must* for the 3V4 when used as a modulator. About the batteries: 45 volts is FB for rf, mixer-oscillator and *if* stages. 90 volts gives better "sock" to the audio output. On some mountains, there is plenty of external noise!

Do *not* use any other values for the second detector and af circuits. The ones shown give plenty of output even though some items, such as what looks like no bias on the first *if*, are shown. Those little tubes work fine with a 10 megohm grid resistor, 5 megohm screen resistor, and a 1 megohm plate resistor.

Concerning loudspeakers, there are quite a few small units on the market. The very best of all that I have tried are the JENSEN THIN-MODELS. It will pay you to get one of these, in the two or three inch diameter size. As mentioned before, there are times when you need all the sound power you've got.

Note that when you are hiking, mountaineering, camping, etc., you do *not* suffer from ignition noise, so no noise limiter is included.

There is an interesting side attraction to this. Lots of hill and mountain tops have parking lots part way down from the top. Even at famed Mt. Cadillac at Bar Harbor, Maine, the parking lot is some 25 feet lower than the top, which is also unfortunately to the South and West. However, with the dry cell station you just get out of the car and walk up to the top, as at Mt. Ascutney in Vermont (500 ft. more elevation), Mt. Kearsage in New Hampshire, and many others. Also, you can climb the fire towers with this rig! Furthermore, all this gets you away from ignition noise kibitzers, Super-Regen TWO-ers, etc.!

This receiver is amazingly sensitive, and with the double-conversion handles very well. It uses one "radio A" cell, 1.5 v (overgrown flashlight cell) and one 45 volt B battery. No attempt was made to gang the condensers, as most of the operation has been on 50 to 50.5 mc. All the receiver filaments are shut off when transmitting. Even the local oscillator comes back in less than a second, as there is no tube heating to contend with.

An excellent antenna for dry cell portable work has been the old faithful dipole. Five foot TV masts, (as many as you feel like carrying!) a piece of linen base bakelite 12 inches long by 2 inches wide bolted on the top of one of the masts, with 4 banana jacks for the 4¼ foot dipole arms (on six meters) to plug into, and 72 ohm *twin lead* for the transmission line, completes the picture. If you cut the dipole to the handbook length, with about ½" between the inner ends, for the frequency, and use the 72 ohm *twin lead*, (this twin lead is a must) it will work FB every time, anywhere, including the stair-landings of most hill or mountain top fire towers. (The cabins are often locked!)

Two matching (matching the transmitter, that is) dry cell transmitters have been used. The easiest to build uses just *one* old reliable 3A5, the two watt double triode, and features

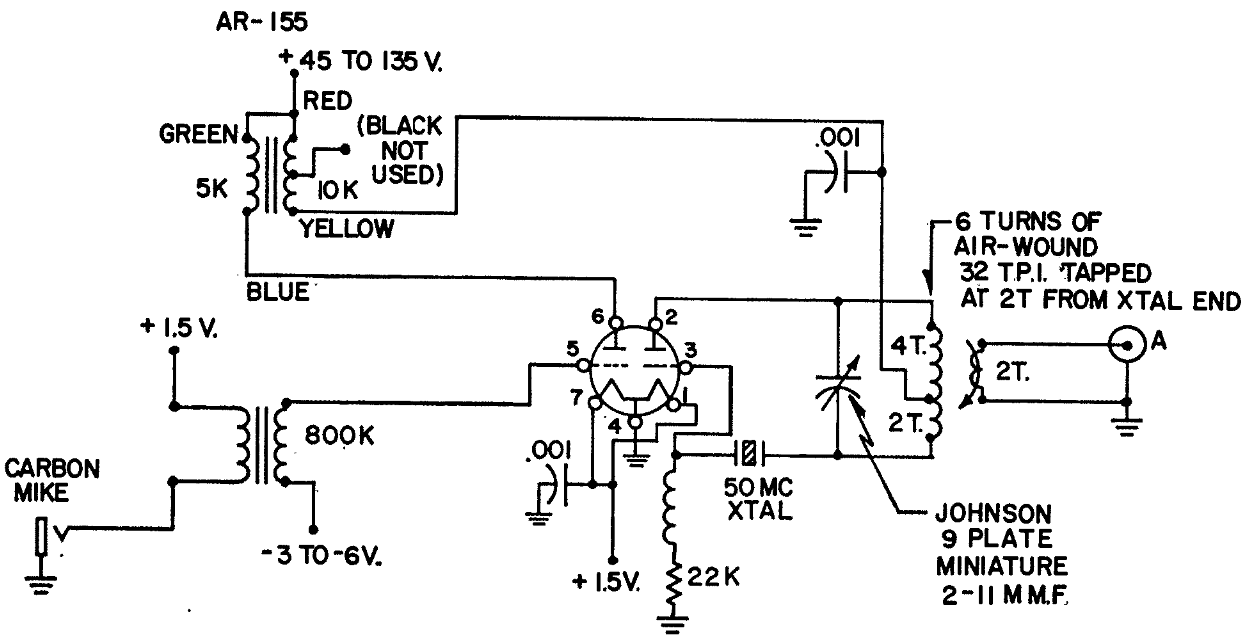


FIG. 2

crystal control and high level modulation in *one* dry cell tube. You have to hear it to believe what is sounds like. Fig. 2 shows the circuit. Taking the cue from several CB manufacturers (RCA for one) that were using a modulated crystal oscillator, it was soon found that excellent quality was obtained this way at some 75 to 80 percent modulation. (It's also legal!) The other half of the tube is the modulator. A carbon mike with a very high gain transformer, 30 ohms primary to 500,000 ohms secondary drives the grid plenty hard. With the tube not lit, *30 volts* of audio can be found on the grid when whistling in the mike.

Another interesting item is the voltage rating of the 3A5. It will take 3 B batteries, or 135 volts all day and like it. It will actually take more, but remember, there is a transmitter wattage level at which it starts to be uneconomical to use B batteries. This is between ½ and one watt. The crystal in this rig is an item requiring attention, not only by the builder, but by the crystal manufacturers. Not all 50 mc crystals are good ones. Some jump a little in frequency, others jump a little in amplitude.

The second transmitter is a "regular" type, although it only uses three tubes. The 3V4, a "dry cell 6L6" type of tube works FB as an oscillator, final, and modulator on 50mc. Caution: Do *not* use more than 90 volts on these tubes! The circuit is shown in Fig. 3. Again the high gain mike transformer is used to advantage. Feeding this audio to the beam power tube as the modulator, this little walking station sounds, on a hilltop, like a big ac rig anchored in the shack.

There is a good plate dip on the meter, without load, and the semi-adjustable antenna link allows easy adjustment of the rf output, which is some 200 milliwatts.

The tinned sockets are soldered on their sides directly to the copper-clad base plate. The whole assembly can be under 2 inches in height. The input power to the final has generally been kept to about 6 ma at 85 volts. This keeps down the B battery buying, and allows use of the small size B's. One of the complete stations weighed only 4 lbs.

A handy method of mounting this type of station is by the use of the multiple-shelf concept. You simply start with the batteries and speaker on the bottom, the transmitter on the next shelf, the receiver on the top shelf, and finally the handle, and/or shoulder strap on top. This also allows easy removal for adjustment, tube testing, circuit changing, etc.

This little rig has been used on many hills and mountain tops (at least, here in New England, they are named mountains) in the East and has worked consistently over 50 miles, using only the dipole.

If you really want a new experience on the VHF bands, try something like the following "Expedition" with dry cell 6 meter operation.

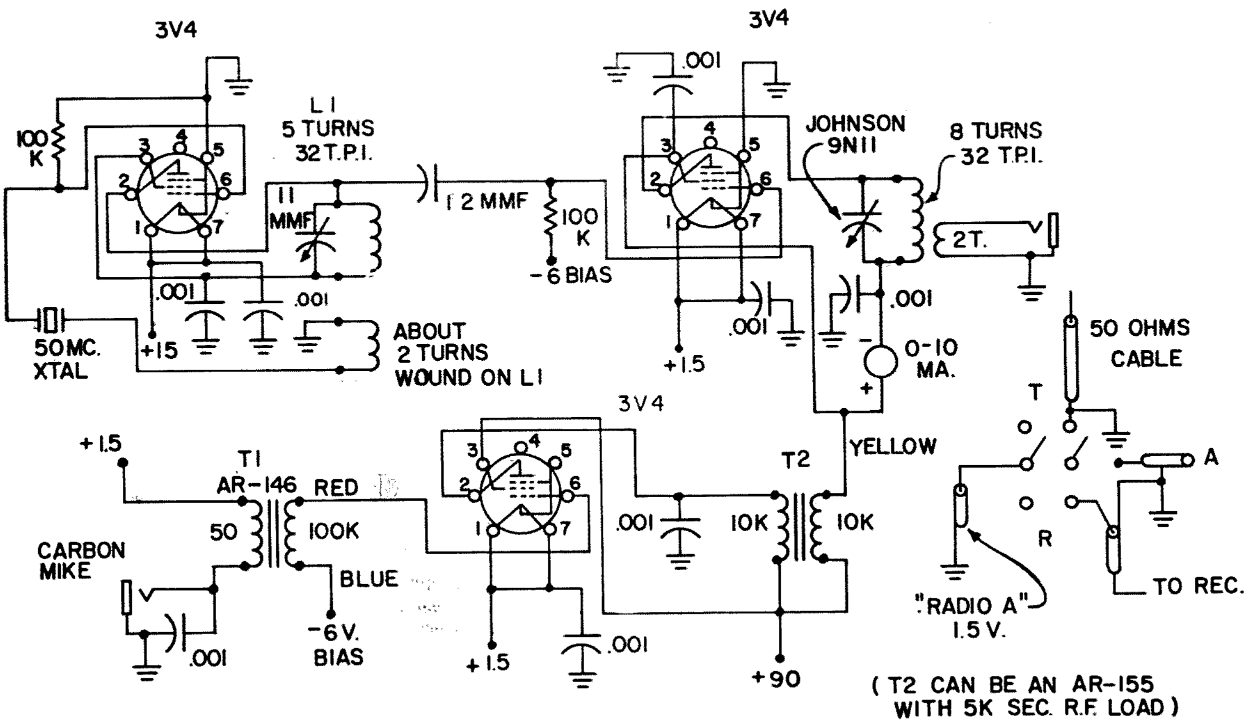


FIG. 3

The receiver shown in Fig. 1 and the 3 tube transmitter of Fig. 3 were used, mounted in a 7X8X2 inch carrying case, weighing about 5 lbs. with batteries. The antenna was the "old faithful dipole" mentioned previously.

First, though, a word of caution about mountains, especially the "walk-up" kind. (After all, we need *all* the mountain-topping VHFers!) Mount Washington here in New England has *killed* over *30* of these walker-uppers! On a bright, sunny, fall day, two people (example) start out; "Let's climb Mount Washington," and the "fun" begins. With shorts, possibly a light sweater, 'I've seen them in shirtsleeves!) up they go. Some time later, on the same afternoon, the sun disappears behind clouds, which begin to move right onto the mountain. The temperature starts to drop like a stone. Next, anyone not already *in* shelter, and I mean good, inhabited shelter, finds cold, wet clouds blowing against them and *through* their clothes at some 20-40 miles per hour. This is *very* bad for the two in shorts, shirts, or light sweaters. The last time I closed down 2 meter operation on Mt. Washington, two young persons were lying dead not more than half a mile away. So, that's enough from the "A word to the Wise" Dept.

The bright side of the picture should be mentioned also. One August day, I started up the big Mount Monadnock, in New Hampshire, on foot with the dry cell receiver described within this article, the 320 milliwatt 3 tube transmitter, and a dipole antenna. There are three of these Monadnocks. "Little" Monadnock has lots of rhododendrons, but that's it. Pack Monadnock is FB for cars. Macadam all the way up to the 2280 ft. top. The big Monadnock, some times called "Man's Monadnock" just because you have to climb it, (I've seen swarms of ten year olds scrambling up) is 3,164 ft., and commands a "Royal Box" type of view (and VHF reach) over all of Massachusetts and Connecticut. It does take about an hour and a half, if you're the usual type of electronic engineer, but it is of course very well worth it. When I arrived at the bare, rocky top at 10 AM, a gentle breeze was blowing, and it was actually warm. The dipole was unfolded (not a "folded-dipole though) and with 10 feet of aluminum TV mast stuck in the rocks, on the air we went on six meters. Plenty of contacts were made with the Boston area, 45 miles away. The dipole was found, as usual, great for nulling *against* heavy QRM.

After lunch, a surprising contact was made. W1HDQ, our good old friend Ed Tilton, long time VHF conductor in QST, was jamming the receiver AVC circuit down from Canton, Connecticut, 90 miles airline. Not having a VFO, I could not raise him, but W1JRW did it for me. Note what happened then. Ed, with *many* years of mountain topping and portable rig experience, told JRW that "I don't think I will be able to hear a 300 milliwatt rig in New Hampshire, especially on 50.2 mc in the middle of a good Sunday." The results just go to show how a really portable rig in a superior location can surprise even the most experienced old-timer. He not only heard the little rig, but we had a solid half-hour QSO! Of course, the big Monadnock is particularly favorable, and I also took all possible advantage of the "favorable slope" principle, by moving the dipole around a *little down* from the top on the Connecticut side. This has often *added* 10 db and did at least as much then.

After signing with Ed, two more stations in West Hartford were contacted, and at QRT time around 2 PM, it was still warm up there. Don't forget, though, that was in August.

Many requests have been received for the circuits used, so we are glad to have this opportunity to describe them. With luck, later notes will take up the 5 watt portable unit using really non-spillable, non-gassing portable storage batteries, that have been charged and discharged *in the rig* for over a year without trouble. (Actually, only *dry* gas comes out of them.)

Also, with still more luck, low-cost, high gain, easy-to-build VHF transistor receivers will be written up to go with the 5 watt rigs.

. . . K1CLL

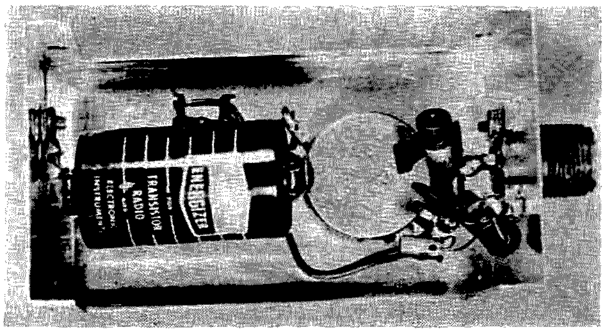
Dear Wayne . . .

The "old time" radio shack has given way to a new idea—the Studio Suite. This is composed of a great front room, draped with layer on layer of Collins Goodies. All lighted and brightly shining—but with all the stand-by switches in. Through a small door hidden at the rear of this Great Show of Might, can be seen a glimmer of another kind. The soft light of a two tube regen, bread-board mounted. Next to this on the rough bench, a simple TNT whose center-tap christmas tree bulbs brighten and dim with the sounds from an old morse telegraph key. And the room is alive with CW which seems to be saying that the rig here is home brew—been enjoying it since 1928.

To my fellow Old Timer, "73 Green" from Lynn Wilson W4JXD

Simple Noise Generator

George Rubis K9ONT
6875 Van Buren Street
Crown Point, Indiana



As anyone knows that has done any work at all on receivers, whether it is a conversion or simply substituting a "hotter" tube in the front end, we get to the point where we begin to wonder if the adaptation was worth while or have we been fooling ourselves.

A noise generator using one of the noise diodes (IN21 or IN23) can give an indication if any improvement has been made.

The circuit is straight forward, but with one addition that others that I have seen do not have. The voltage is regulated by a Zener diode.

The reason is obvious to anyone who has worked with the simpler type of noise generator. The results are not always consistent from measurement to measurement and from day to day. The voltage and current vary with the setting of the variable resistance and due to the normal aging of the battery.

The Zener Diode eliminates this by maintaining a constant line voltage. In our particular instrument it is six volts. Of course we must use a battery in excess of six volts. Nine volts is a good value. I have found that used transistor radio batteries still have enough life in most instances to last for many tests.

One of the main requisites of a noise generator is that it must be shielded throughout. Therefore we must give some thought as to the placement of the various components.

A Mini-box 2¼ x 2¼ x 4 is an ideal size. As for a connector I used the SO-239 coaxial. I find that this connector allows more flexibility than any other. If a direct connection to the receiver is desired merely attach it through the double connector type DKF-2 made by Dow Key. On the other hand if it is desired to have the controls of the noise generator close at hand merely connect a length of Coax of eighteen inches or so. I haven't been able to discover that it has affected any measurements to any degree.

In the construction of this noise generator just remember a few basic rules. Keep all connections as short as possible. The noise diode and bypass condenser and resistor (50 or 75 ohms as the case may be) as close as possible to the output plug. Remember to use pliers to absorb the heat when soldering the leads of the diodes.

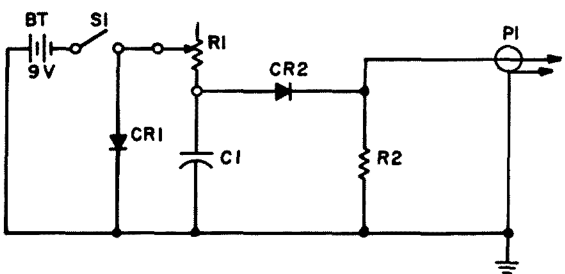
To mount the silicon diode, which has one large end and one small, we must improvise to a certain extent. For the small end a lug from one of the old tube sockets will do. For the large end use a small fuse clip.

Don't be too fussy about the variable resistor. For most purposes any value from 10M up to 50M can be used.

The battery you choose will determine the manner of mounting.

No need to give detailed instructions as to the use of this noise generator. There are ample instructions to be found in various magazines as well as handbooks.

. . . K9ONT



To avoid excess wear and tear on the zener diode and the battery a 200 ohm resistor should be inserted between the 9 v battery and S1.

Parts List

2—¼ x 2¼ x 4 Minibox
Bt—9 volt battery
Cr1—6 Volt Zener Diode
Cr2—IN 21 or IN 23 Silicon Diode
R1—10M-50M Variable
R2—51 ohm or 75 ohm (according to your line)
C1—.001 to .005 disk ceramic
S1—S.P.ST. this may be on your variable resistance
P1—So-239

Parts Kit Available

The parts for noise generator are available as a complete package from 73, Peterboro, N. H.
Order K9ONT Kit $5.00

Video Modulation

Robert Walker W8VCO
1849 Meadowlark
Toledo 14, Ohio

In recent issues of 73 I have read several articles on amateur television systems. I thought there might be some interest in video modulators. There are many systems in use today and the direct plate coupled modulator to be described is one of them.

There are many conditions to be considered. The prime concern will be the final amplifier stage. In our shack we are operating on 432 megacycles, and am using a 4X150-A in the final rf amplifier. To start with we had to know the operating characteristics of the 4X150-A. The curves given in the manuals that were available here in the shack were not accurate enough to be of any value. So we set about to run a set of curves for the final amplifier stage.

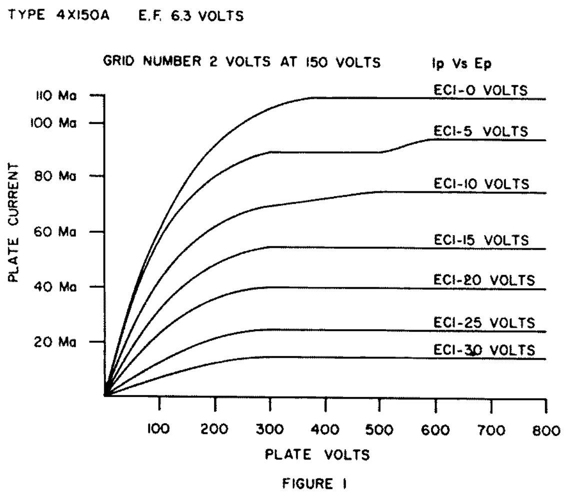


FIGURE 1

We plotted Ip versus Ep with various values of Eg, the screen grid voltage being regulated at a positive 150 volts. The curves shown in Fig. 1 are typical for the 4X150-A.

Actual operation of the final was run with 580 volts on the plate; 150 volts on the screen grid; plate current was running 0.080 milliamperes; and a bias on the grid of –8 volts. The cutoff point of this particular 4X150-A was with a grid voltage of negative 42.0 volts.

Now in order to modulate the final 100% with the composite video the synch tips (blacker than black) must run the carrier to a maximum value, in our case to 0.080ma of plate current; and the whites of the video to decrease the carrier to very nearly cutoff. This point being within 10% of the cutoff point of the carrier.

The next condition to consider is the amount of video required to meet these conditions. Thus Fig. 2 was evolved. This curve plots Ip versus Eg with Ep being constant at 580 volts, the screen regulated a 150 volts.

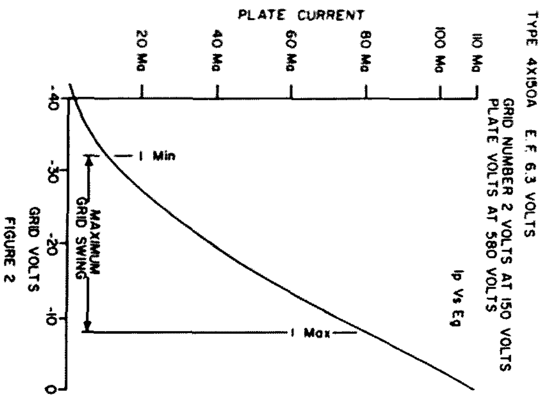
In actual practice we found that the best setting for the whites of the video was with a bias of –31.5 volts being developed. If this value is exceeded the whites will wash out, and cutoff the carrier between the blanking pulses.

Referring to Fig. 2 it is evident that the composite video will have to have a peak to peak value of –8 volts to –31.5 volts swing on the grid in order to produce 100% modulation. This means that a peak to peak value of 23.5 volts

is required to drive the final amplifier from a maximum value to a minimum value for 100% modulation.

The type of video modulator selected was the direct coupled, with a common load resistor for the plate of the modulator and the control grid of the final amplifier. The modulator having a condition of operating as a triode. The 6L6 was selected for this particular function.

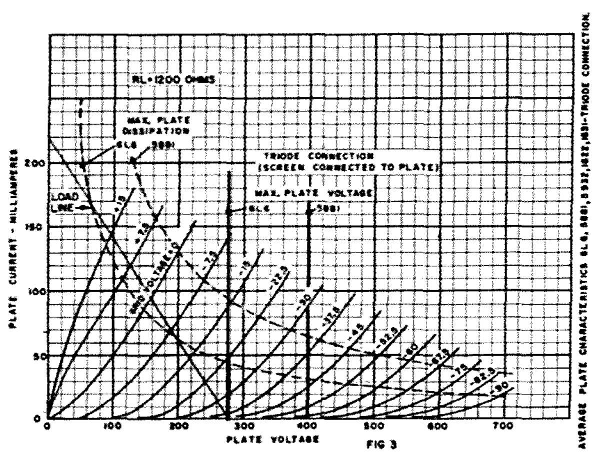
Fig. 3 shows the family of curves for the 6L6 triode operation. The load resistor is a 1,200 ohm with a rating of 4 watts. The bias on the video modulator is adjustable and is normally set in the vicinity of −22 volts.



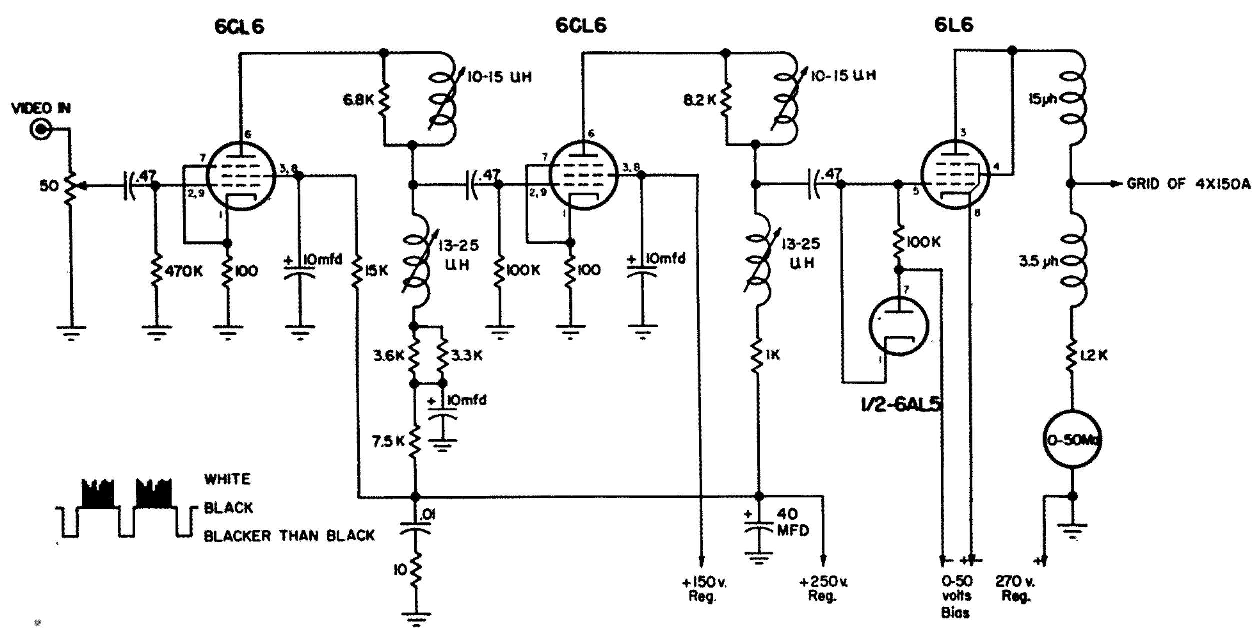
Theoretically the modulator should be operating at cutoff, but due to the conditions of the existing amplifier a little fudging is necessary. After this fudging the the video modulator will draw some idle current. This value being in the order of 0.022 milliamperes.

A 6AL6 was used to clamp the composite video signal on the control grid of the modulator tube. The ref-point of the synch tips must remain at a constant position and not drift.

Fig. 4 is the schematic for the video modulator. The average plate current of the 6L6 video modulator is 20 milliamperes plus or minus 2 milliamperes with video information on the control grid and rf excitation.



VIDEO MODULATOR
FIGURE 4



In the process of putting video on the air, it will be necessary to monitor the video in the transmission line. Fig. 5 illustrates a typical detector for the composite video information. The type UG tee connector was modified by removing the dielectric insert and installing a small loop. This which is placed in a plane parallel to the conductor. A 6AL5 is used to demodulate the video from the rf.

An oscilloscope or TV monitor may be used to indicate wave form or picture.

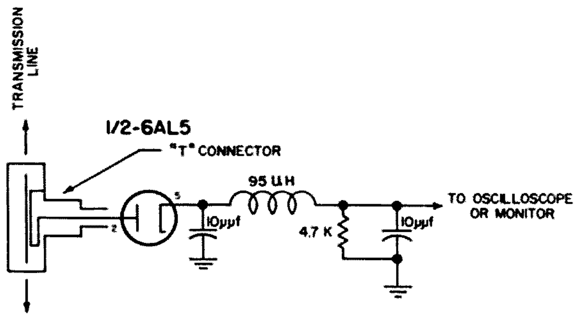
Normal procedure should be used when first tuning up the transmitter. Before applying video through the modulator, the bias on the 6L6 should be adjusted to −22 volts. Note also that the plate current meter should be indicating a current of approximately 20 milliamperes. Now begin to increase your video until you indicate video output. In doing this you will have to reduce grid drive, which may be accomplished by decoupling to the grid of the final amplifier. As the video is increased it is possible to overdrive with the same and the whites will begin to washout. It will then be necessary to decrease video gain. At this time it may be necessary to readjust the value of the grid bias on the grid of the video modulator stage to improve picture quality. Actually what is needed is about three arms and hands. Once the operating point is pretty well adjusted on the transmitter, back the video off and then increase the video so that the synch tips give maximum current and video itself is within 10% of carrier cutoff; usually when the video cuts off the carrier the whites will wash out.

If after making several repeats the preceding adjustments are completed and you are satisfied, then by merely adjusting video gain control you will be able to adjust for various levels of video information with ease.

So there it is, this our video modulator which we are at present using on our rig.

We have a complete system for the transmission of TV. Observe the photograph that was taken at a receiving station 15 miles away. If the article is what some of you are looking for, let's hear from you. We have much more information we could put into the 73 Magazine.

. . . W8VCO



TRANSMISSION LINE DETECTOR
FIGURE 5

Letter

Gentlemen:

I've heard that the Heath Twoer can be converted to 220 mc by doubling in the final amplifier and reworking the superregen coils. Perhaps some 73 reader can provide a conversion.

W. W. Warner K8RSC

The Magic T-R Switch

Jim Kyle K5JKX
1236 N. E. 44th Street
Oklahoma City 11, Okla.

Despite the multiplicity of circuits listed in the various handbooks, we still don't have a perfect T-R switch of the no-moving-parts variety to fill all needs.

Granted, some pretty good designs have been described and are in use—but none of them yet has been fully applicable to all ham uses. In the VHF region particularly, the perfectionist still insists on the relay, even if it is slower and clanks loudly in the background.

The major objection to the conventional T-R switch at VHF, of course, is that it reduces receiver sensitivity. It hardly makes sense to beat the bushes for a device capable of 1½ db noise figures, then put a 10 db T-R switch in front of it! And even if this could be overcome, there's still the question of transmitter noise showing up to hurt the S/N ratio.

What we need, of course, is a devise which will completely disconnect the transmitter from the antenna while the receiver is in use (and vice versa) without introducing any noise of its own, and without moving parts. In addition, it would be nice if this gadget could be built inexpensively.

Strangely enough, the microwave gang have had shuc a gadget around for 20 years (or more). It's a mystery why no one has thought of adapting it to this use previously.

We refer, of course, to the so-called "Magic Tee". This, in its original form, is a rather complicated mass of waveguide, which has the "magic" property of routing signals from any port to both adjacent ports, while retaining almost total isolation of signals between alternate ports.

The waveguide, of course, isn't much use at frequencies below the upper UHF range—but a coaxial analogy of the Magic Tee, known as the "hybrid junction" or hybrd rng," was described on page 353 of the third edition of *Reference Data for Radio Engineers* in 1949!

The basic circuit is shown in Fig. 1. Here's how it works: assume that you have connected a transmitter to input 1, and the other three ports are all terminated properly so that SWR on the lines leading away is 1.0 (this is important).

The signal from input 1 to input 2 may go direct via the quarter-wave portion of the ring, or "long path" through the ¾ wave leg, and two more quarter waves in series. The total length of the "long path" to input 2 is thus 5/4 wavelength, or one full wave longer than the short path. Energy repeats itself in both amplitude and phase every full wavelength (the half-wave "repeater" is actually a phase inverter) and so we can subtract one wavelength from the long path, which makes it exactly equal in length to the short path so far as the rf is concerned. And since the two paths are of equal length, they have no effect on the rf appearing at input 2 except to reinforce each other.

However, at input 3, the picture is a bit different. Energy arriving there from input 1 also comes through two paths; one is a half wave long while the other is a full wavelength. Thus the rf from one path is exactly 180 degrees out of phase with that from the other path, and it cancels itself out.

At input 4, the situation is he same as at input 2. The only difference is that both paths are now ¾ wave long.

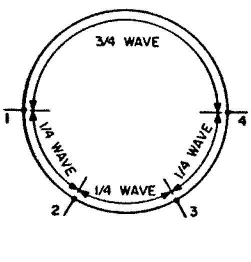


FIGURE 1

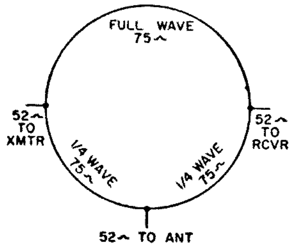


FIGURE 2

A bit earlier, we said that all lines must be terminated so as to have no standing waves on them. Here's why: if the line away from any port on the ring has standing waves, some power will be reflected back into the ring at that point—and this reflected power will no longer have the proper phase relationship to permit complete cancellation.

So here we have the ring and how it works; now what do we do with it?

The suggested operational circuit is shown in Fig. 2. (As this is written the author is on a temporary assignment far from his equipment and has had no opportunity to prove the idea in practice. It ought to work nicely—but if you try it, remember that all is experimental and don't use your 416B until you have tested with less exotic equipment!) Note that this has only three ports rather than four. The long path has been extended another quarter wavelength to preserve phase relations.

Note also the various impedance levels of coax specified. The discerning reader familiar with quarter-wave transformer action may have been wondering what of this nature happens in such a circuit; maintaining the impedance of the ring itself at 1.4 times that of the various feedlines keeps the quarter-wave sections under control. If you are using 52 ohm coax (as most of us seem to be) then 75 ohm is a natural. If you're using 75 ohm, you have troubles ahead since 100 ohm coax isn't an over-the-counter item. Best suggestion: transform down to 52 ohms befor reaching the ring.

Construction of the ring should not be difficult. When calculating length of each section, don't forget coax velocity factor. In fact, we recommend trimming each to length with a grid-dipper at the center of the most-used part of the band, for increased precision—because the cancellation will be total at only *one* frequency, and effective bandwidth of this device is one of its unknown quantities. It will certainly be sufficent for use, but may not permit much in the way of QSY.

Once built and connected in your transmitter-receiver-feedline hookup, it may require some adjustment. The transmitter and receiver must both present 50 ohm input impedances when viewed through the antenna terminal for proper operation—and many of them don't do this now.

Best way of adjusting receiver input impedance is to modify the L-C ratio of the antenna coil, measuring with an Antennascope and GDO to get into the right region. Once there, fire up the transmitter at low power and continue adjusting until you have a minimum of fed-through power from the transmitter showing up in the receiver.

Only perfectionists need worry about the transmitter input impedance, since its only effect would be a very slight reduction of received signal—probably not enough to be noticed even on a marginal signal. Best way of modifying this would probably be to prune the line from transmitter to Magic Tee, which would change the effective impedance seen by the Tee even though i twould have little actual effect on SWR.

So there you have it—a T-R switch offering theoretically total isolation at any one frequency, introducing no noise, and in addition capable of being built at home for pennies. Try it, and let us know how it works out.

. . . K5JKX

A Look at Antenna Gain

Jim Kyle K5JKX

It's common belief among VHF/UHF minded hams that the parabolic reflector is the ultimate in antenna design and that things such as the ancient collineararray are virtually obsolete.

So maybe it's time to do a little comparative checking into the relative gains of different types of antennas, and see just why some have better reputations than others.

The accompanying chart shows a comparison of db gain figures and effective aperture areas for several of the more popular types of antennas, as well as some unpopular types and one which is impossible. It leads to some interesting conclusions.

For instance, we note that for the same physical size, the old-fashioned collinear leads the league when it comes to gain, with the corner reflector running a very close second. So why is the collinear losing ground, and the corner reflector almost ignored?

A large part of the answer lies in the fact that the figures shown here are the *maximums* which can be achieved, and many of the more popular versions of these antennas fail to meet this level of performance.

In addition, a collinear of any appreciable size almost always runs into feed-line and phasing problems which limit its *attainable* gain to something in the neighborhood of 20 db.

The corner reflector's wide horizontal angle has helped keep it in the little-used stack—although K2TKN has employed this cnaracteristic to good advantage in a beacon-antenna design.

The biggest reason parabolic dishes have become so popular, however, is their independence of frequency. An 8-foot dish, for example, is equally adaptable to operation at 100 mc or 10,000 mc. The difference is that it will have only 6 db gain and something like an 80-degree beamwidth at 100 mc, while at 10,000 mc the gain has climbed to 46 db and the beam has narrowed down to about 4/5 of a degree wide—just wide enough to hit the moon!

None of the other antenna designs listed in the chart, except the horn, have this characteristic. And the horn is not particularly amenable to changes of orientation, so necesary in ham work.

Note that for those antennas in which size is not fixed precisely by the frequency of operation, two standard sizes have been employed in preparing the chart. This is to give you some idea of the way in which gain varies with physical size, and also shows you approximately how much space would be required for any of the designs. In the chart, the symbol A represents actual physical surface area, L represents total height, and N represents the number of elements employed in the array. Out of respect for the printer, wavelength is represented by W rather than the more usual Greek lambda!

. . . K5JKX

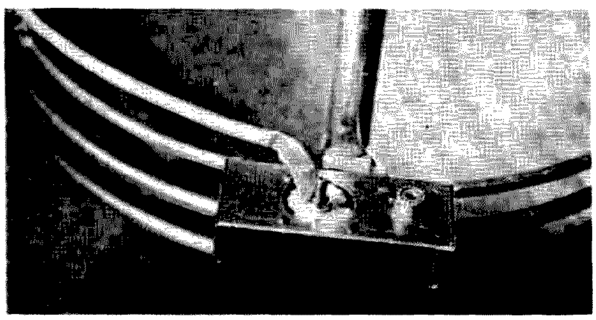
Table I. Comparison of Antenna Gains and Apertures

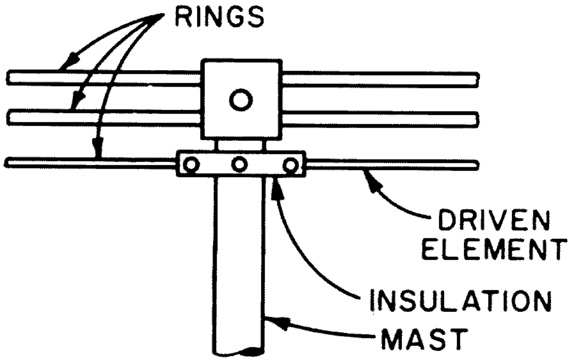
Type of Antenna	db Gain	Aperture
Isotropic point source	0	$0.07956W^2$
Small loop or halo	1.761	$0.1193W^2$
Half-wave dipole	2.148	$0.1305W^2$
Stacked haloes	10 log (2L/W)	LW/6.28
4, ½ wave apart	4.77	$0.2387W^2$
Parabolic reflector		
1 wavelength dia.	6.74 to 7.7	0.5A to 0.6A
2 wavelength dia.	13.0 to 13.7	
Optimum horn		
1 wavelength square	10	0.81A
2 wavelengths square	16	
Corner reflector		
1 wavelength square	10	0.71A
2 wave, 60° angle	13	0.5A
Broadside array (collinear)		
1 wavelength square	11 (max)	A (max)
2 wavelength square	17 (max)	

Modification of the Saturn 6

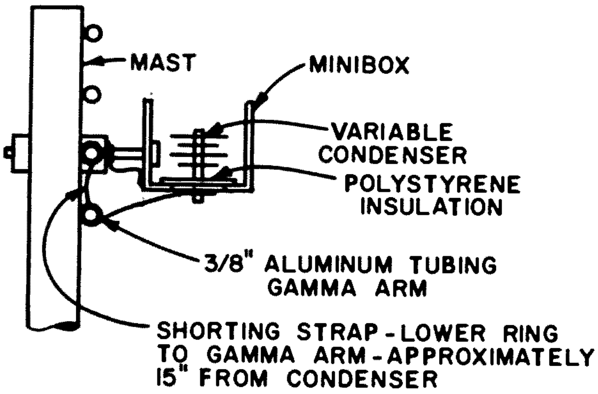
Ralph Bradford K5LPE
Ernest Williams W5CWS

The authors acquired a pair of Saturn 6 halo antennas with the idea of using them in club and Mars nets. They were tuned to the desired frequency and the Q section prepared as recommended by the manufacturer. Results were very poor. In good weather a high swr was obtained and during rainy weather the swr was even higher. Experimentation followed resulting in a modification employing a Gamma match. Bud Minibox 5″ 1 2-¼″ w 2-¼″ h was used as an enclosure for the variable condenser and coax connector. A 1-½″ hole and a ⅝″ hole were cut in the bottom of the U-shaped part of the box. A piece of 1/16″ poly-



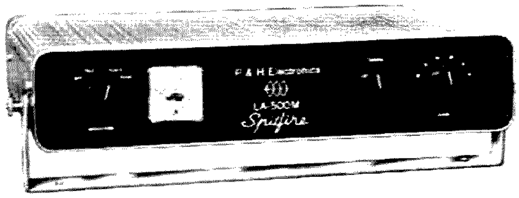


ORIGINAL ARRANGEMENT



AS MODIFIED

styrene was attached to the box over the 1-½″ hole using 4-40 volts and epoxy resin. A small 50 mmfd variable condenser was mounted in the center of the polystyrene. The coax connector mounted in the ⅝″ hole. Two holes were drilled in the side of the same unit and connected across the two bolts holding the lower ring sections to the insulation material. The center bolt holding the insulation material to the mast must be grounded to the minibox. The coax connector is connected to one side of the condenser inside the minibox. A ⅜″ diameter piece of aluminum tubing is connected to the condenser on the outside of the minibox. This tubing is extended to a position under the lower ring of the halo and then bent to follow the curvature of the halo. It is 15″ long and is spaced ⅜″ below the lower ring of the halo. Closer spacing of the tubing will require a different length of tubing. Do not allow this tubing to touch the minibox or mast. Using this modification, the authors have obtained a 1:1 swr and in rainy weather a 1.5:1 ratio.



Utopia Break-in

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Ask any CW operator what he'd most like to have—all expense aside—and after he named his favorite dream receiver and a full KW to a stacked rotary 80-meter rhombic, he'd probably name complete break-in (QSK) as his secret desire.

The advantages of a system which will let you "hear through" your own sending to keep track of what's on the frequency are so obvious they don't need exposition. But for some reason, a superstition has grown up that this is next to impossible to achieve in practice.

Perhaps one reason it *seems* too difficult is that there persists a popular illusion that QSK is something you *ought* to be able to have for 10 minutes work and a couple of small resistors or diodes.

It *is* simple. But it's not all that simple, and you might as well resign yourself to a circuit using a couple of tubes or transistors, a power supply, perhaps a relay or two and a handful of small parts.

There are probably as many systems for QSK as there are operators using them. And one operator may regard as "complete" break-in what another operator may regard as semi-break-in.

For our purposes, we'll consider a complete-break-in system as any lashup which will permit a CW operator to go from transmit to receive and back again using only his key to do it—and which will permit him to hear signals in his receiver during brief pauses in his transmissions.

This includes even those systems which tend to blast the ears off the operator through receiver overload, and those systems which turn off the receiver for whole characters and words at a time, opening it up only during the longer pauses between words or sentences.

Actually, QSK demands of a station that it be a closely coordinated unit, with receiver, transmitter, monitor and antenna controls all operated automatically and at high speed by the key—*and with no other controls or switches.* This is the *sine qua non* of QSK operation.

This requires that the transmitter oscillator (or mixer if its a heterodyne rig) be keyed, so that there's no signal to block the receiver during pauses in the transmission.

The receiver must be keyed, so it will be "mute" during key-down, to avoid all kinds of squawks, grunts, clicks, screams, screeches and thumps which result from overloading it with the transmitter signal.

It requires a means of monitoring the keying, so that the operator can tell what he's sending.

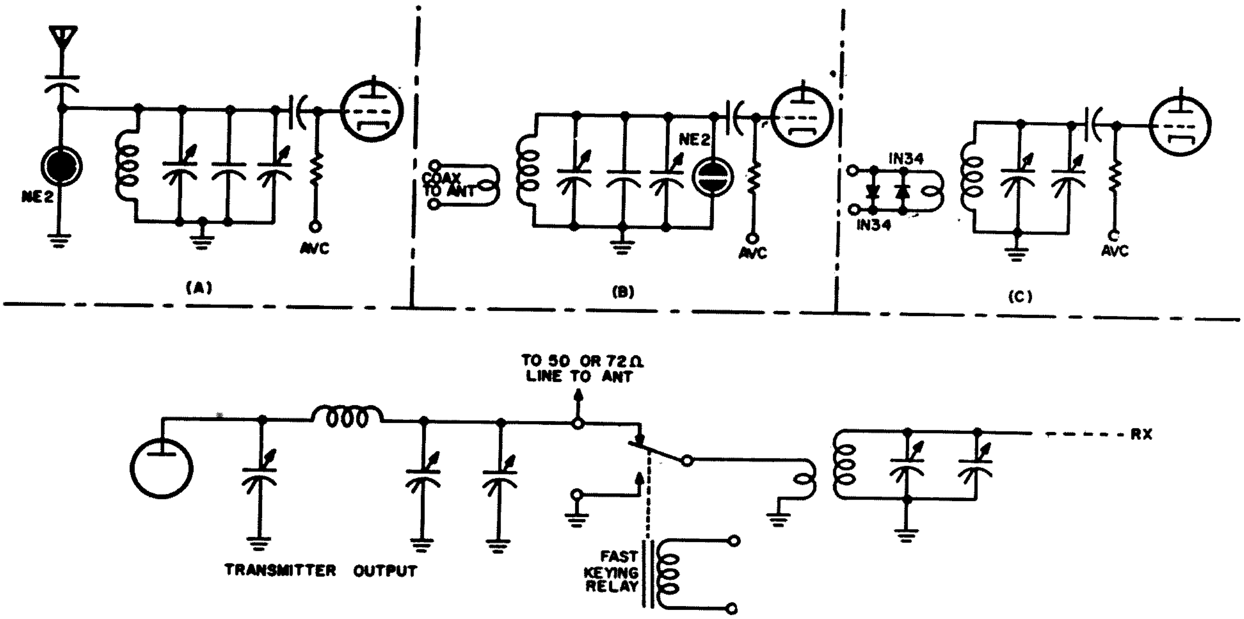
And it demands some means of protecting the receiver from damage by the transmitter's rf.

Receiver Protection

This is one of the simplest demands to meet. Most receiver front ends are pretty rugged these days and there are many ways of protecting them from rf damage.

One of the most common, and one of the best, is the TR switch, which permits use of the transmitting antenna for receiving. There are a million circuits (more or less) for TR switches, so we'll just mention the method here and let it go at that.

A method used in the popular surplus Command Receivers is to put an NE-2 or NE-1 across the antenna terminals of the receiver. Normally this has no effect on reception. But when the rf peak voltage is high enough to fire the tube, it appears as a dead short across the antenna, "clamping" the voltages which appear on the receiver antenna coil and first rf amplifier grid. The ARC-5 receivers had a high im-



pedence antenna connection. Most modern commercial receivers use 52 or 72-ohm inputs and rf voltages seldom get very high, even with a powerful local transmitter. The danger point is the *secondary* of the first rf transformer—at the grid of the rf amplifier. Good practice would be to install the neon lamp from grid to ground of the rf amplifier tube. (Fig. 1 A & B)

Another method is to use a pair of diodes (e.g. 1N34s) connected in parallel, back to back, across the antenna terminals. These diodes have no effect on reception because even their forward resistance is very high when measured at a few millivolts. However, when the transmitter goes on, rf potentials at the receiver antenna terminals get up to at least several volts—even on low impedence inputs. At these voltages, the diodes' forward resistances are very low. They're connected in reverse polarity to each other, so they "clamp" the rf input to very low voltages. (Fig. 1 C)

A very fast acting relay can be used to remove the receiver input from the antenna feedline and ground it. The relay handles no rf power, so any very light duty, fast acting relay, such as a keying relay, can be used. (Fig. 1 D)

All of these methods (except the relay) are potentially capable of producing TVI because of the clipping of the rf signal, which occurs at the limiting device. The usual anti-TVI measures should be effective.

Keying the Transmitter

Most modern transmitters interrupt the oscillator signal when the key is up. If yours doesn't do this, but keys a buffer or the final, you'll have to modify it so that the oscillator can be keyed. This is a problem you'll have to solve yourself, perhaps by referring to other articles on keying in the amateur magazines and handbooks. A word of advice, however. Grid-blocking keying methods are generally more easily adaptable to QSK systems than cathode or screen keyings.

On the subject of oscillator keying, it is worthwhile to mention that other systems do

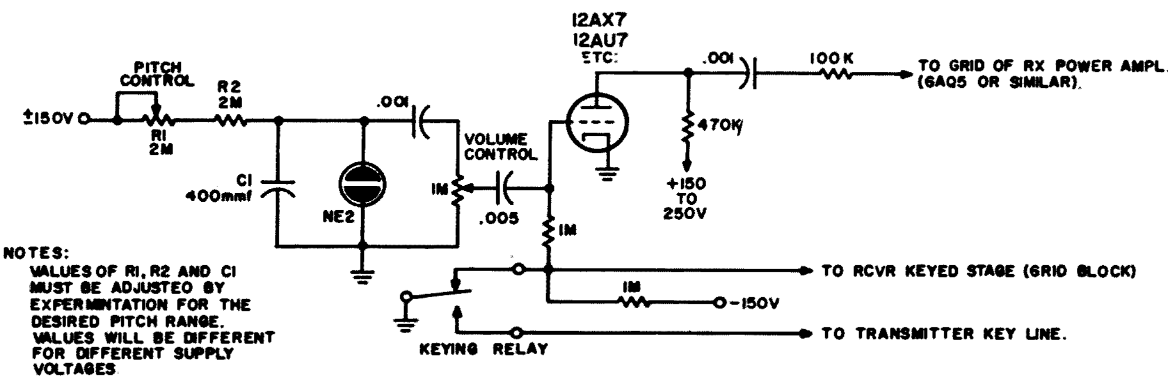


FIG. 2 SIMPLE KEYED SIDETONE GENERATOR.

exist for keeping your oscillator from interfering with reception on the same frequency. It is possible, but very careful shielding and use of very low powered oscillators, to let the VFO run continuously, and to key the following stages only. It is possible to make the oscillator inaudible in the receiver but the care and elaboration of mechanical detail is greater than most hams like to try. Heterodyne exciters, of course, may be keyed in the mixer, since both the oscillators are off the operating frequency and may be left running at all times. And frequency shift keying has been used by a few hardy experimenters with varying degrees of success. In this system, the oscillator is left running, but keying inserts inductance or capacitance which shifts the frequency to the desired operating frequency. When key goes up, the VFO swoops back to its resting frequency. This system, of course, also requires that following stages be keyed, and that time sequence keying be used to eliminate the chirp. I don't recommend the system (nor recommend against it). I mention it in the interest of completeness.

Monitoring

Two methods of monitoring are in common use in QSK stations.

One uses the receiver (or a separate receiver) to listen to the transmitted signal. This requires that the monitor be tuned to the operating frequency.

While a receiver makes a perfectly satisfactory monitor—and superior in some respects to other monitors—it requires constant retuning if you QSY much. It's almost helpless unless you constantly work directly on your own frequency, and when working DX this is often not desirable. A separate receiver, of course, permits working off your own frequency. But have you ever tried working a contest like FD or SS while tuning *two* receivers, plus your VFO, logging and hunting new territory at the same time?

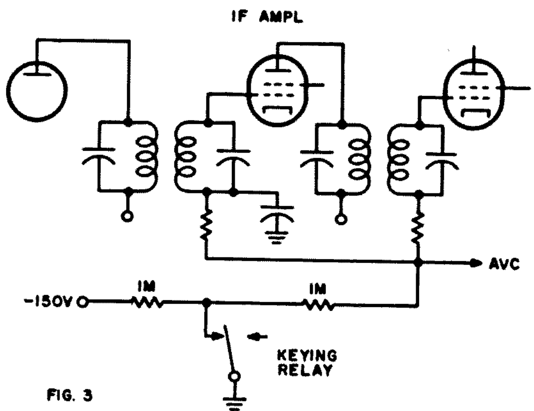


FIG. 3

The alternative is the use of a sidetone generator (audio oscillator) whose output is either fed directly to a speaker or injected into the receiver audio amplifier so that it comes out where the rest of the audio comes out. (Fig. 2)

The sidetone is keyed along with the transmitter by some means, such as an extra pair of contacts on the keying relay, a separate relay controlled by the keying relay, or blocking grid bias controlled by the transmitter keying. Some sidetone oscillators use transistors which derive their power from rectified rf picked up from the final. •

Muting the Receiver

This is the aspect of QSK operation which has baffled so many operators who attempt break-in operation.

Owners of Collins 75A and S-line receivers, Drake 2-Bs and some others with good CW AGC circuits have this problem practically licked. They just let the AGC handle the receiver quieting and let it go at that. It works OK, if you use a sidetone when working off your own frequency.

Another common (though not painless) method often used is the "let 'er grunt" method in which the receiver is simply run at normal gain and the rf overload is relied on to do its own muting. This works with some receivers which overload nicely. (I once used a Hammarlund HQ-110-C which did fine this way.) Of course, both this method and AGC method provide their own monitor signals. The disadvantage, of course, is the same for both—you have to listen on your own frequency. Some receivers don't take kindly to this treatment and the resulting screams from the loud speaker can be heard all over the block—until drowned by screams from outraged neighbors. Hammarlund crystal filter receivers old and new usually fall into this category, and so do many other makes and models.

A third (and somewhat more sophisticated) means of receiver muting sharply reduces the rf and *if* gain of the receiver each time the key goes down. This is really a manual variation of the AVC method, but it must be accomplished externally by some device, such as switching diodes, or transistor or relay. There are a number of means of keying a receiver's rf gain (or "sensitivity") so let's look at a few circuits and methods.

AVC Blocking

On many receivers it is possible to lift the AVC bus from its ground return and inject a blocking bias voltage whenever the transmitter

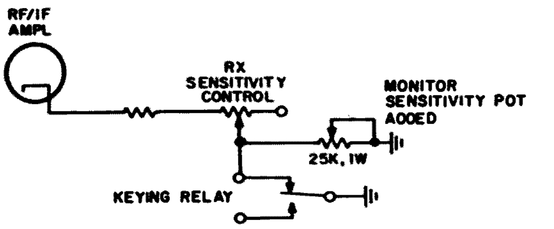


FIG 4

is keyed. This, often, can be adjusted so as to reduce the sensitivity to any desired degree, from a slight reduction to complete cut-off. (Fig. 3)

On some receivers, it is difficult or impossible to isolate the AVC bus in this way. In others, recovery time after the blocking bias is removed, may be too long for practical break-in.

RF Gain Keying

Many receivers use a pot on the cathode circuit of the rf and *if* amplifier tubes to vary the bias—and hence the gain—of the stages. With these receivers, a relay may be used to insert a high value of resistance in the cathodes when the key is down, thus reducing receiver sensitivity. (Fig. 4) This method has a tendency to be quite noisy, since it may respond loudly to the first few cycles and the last few cycles of the keyed characters from the transmitter. Some effort with timing circuits, however, will usually remove these clicks. Timing circuits won't, however, remove clicks generated within the receiver by the keying of its *if* amplifier strip.

As with other *if* muting methods discussed so far, it is necessary to listen on your own frequency unless other monitor methods are used.

With all methods of rf/*if* sensitivity keying, any clicks, thumps or spurious responses generated in the receiver by the keying will be amplified by following receiver stages and a very small click at the origin can assume ear-splitting proportions before it emerges from the phones or speaker.

T-R Switch

The TR switch was mentioned earlier as a means of antenna protection. It can also be a good receiver muting device *provided* the receiver is excellently shielded against pick-up of stray rf through anything but its antenna terminals.

To test this, disconnect the antenna from the receiver, replace it with a small composition resistor of the proper value (usually 50 to 75 ohms) and shield the resistor itself from rf by enclosing it in a small metal box or can.

Turn on your transmitter, tune in your signal and hold the key down (with antenna on the final and the rig tuned to a clear frequency or on top of a foreign broadcast or commercial station in an amateur band). (The chances are good that *any* output is going to QRM somebody. Why should that somebody be a ham when there are so many other handy signals around?)

If you can hear your transmitted signal only faintly (S-5 or less) chances are that you can use T-R switch receiver muting. If it is more than about S-5, either plan another kind of muting or prepare to do some fancy modifying, shielding and by-passing of your receiver to get ride of stray pick-up. (This could be worthwhile in itself, especially if you use a beam. Stray pick-up can play hob with your front-to-back ratio.)

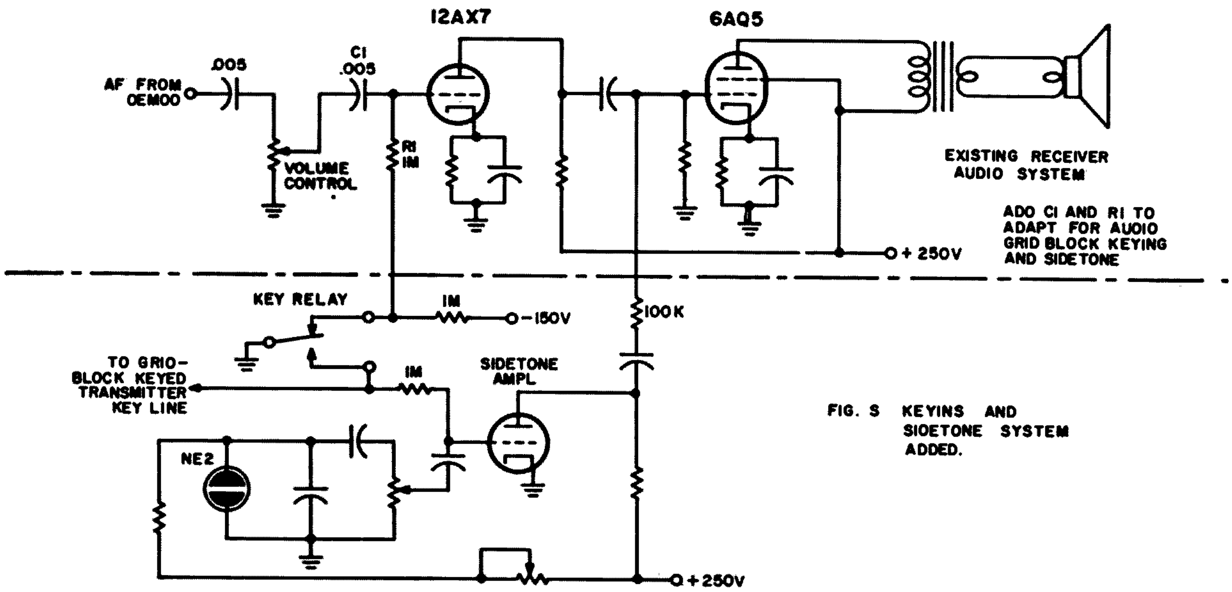


FIG. 5 KEYING AND SIDETONE SYSTEM ADDED.

If you plan to use TR switch muting, the best way is to grid-block key the tube(s) in the TR switch with a high negative voltage (150v or so). Naturally, this also takes care of receiver front end protection.

Audio Muting

It is quite possible, of course, to mute the audio portion of the receiver, thereby largely eliminating the problems of click and varying rf sensitivity of the receiver on various bands and with various antennas.

Audio muting, naturally, means that you *can't* listen to your own signal in the receiver. So you must provide a monitor signal from a sidetone generator. This can be injected into the audio amplifier at a point following the muting cut-off, or it can simply be fed to a separ[illegible]

which will permit you to hear the band at all times when the key is up.

(3) Some means of keying the receiver off when the transmitter is keyed on.

(4) Some means of monitoring your own sending.

There is a wide variety of choice in ways to accomplish each step. The over-all system must operate as a *system* and not as a melánge of separate and disjointed units.

The results are worth every bit of effort it takes to accomplish QSK. And the ability to work full break-in with *no effort* is a very large factor in enjoyment of all types of operating—rag chewing, DX, traffic and contests.

But a warning—once you get used to QSK, you never want to go back to cruder systems. You feel absolutely "blind" if you can't hear

A Practical Vee Beam Design

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How would you like to put a kilowatt on 20 meters? "Great," you say, "but too expensive." Not necessarily. The following article will describe how to do just that. The amount of input power you will need to get an effective radiated power of 1000 watts will depend on several factors including the space available for an antenna.

Described is a Vee antenna that will:

1. Operate on all bands from 80 meters up,
2. provide gain compared to a half wave dipole even on 80 meters,
3. be easy to feed and load on all bands,
4. be simple to construct and get on the air,
5. be very inexpensive,
6. provide for switching the direction of the beam without resorting to rotators,
7. occupy no more space than an 80 meter half wave dipole.

If this kind of antenna is what you have been looking for, read on.

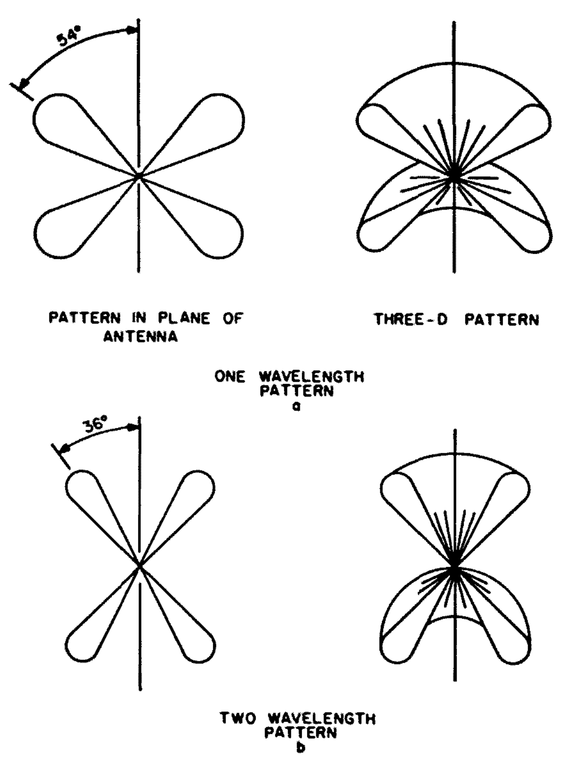

FIGURE 1

Depending on what you have available in the way of natural supports (trees, buildings, etc.) the materials for this antenna will cost less than $10.00. If you have to erect one or more supports the cost will, of course, increase. Even if you have to construct your Vee from scratch, the cost will be appreciably less than an equivalent store-bought beam, and you will have an all-band antenna in the bargain.

Just to convince you of the capabilities of the Vee antenna let me briefly tell you of the incident that sold me. Not too long ago I had occasion to spend about six weeks in sunny Southern California. Naturally the rig went along. All sorts of antennas were tried, with varying degrees of success (mostly poor). Finally, it was decided to try the little known Vee. One thousand feet of No. 26 enameled wire, one hundred feet of 300 ohm twin lead, a ball of twine, a couple of fish sinkers and a baseball pitcher completed the list of materials. Of course, the pitcher was only used to accurately throw the fish-sinkers over a tree limb. The sinkers were left attached so that they acted as automatic tension adjustment. The actual job of getting the wires up in the air was much more simple than trying to describe it.

At any rate, the following day a phone contact was made on 15 meters with a W2 in upper New York State. He gave me a signal report of Q5-S9. My rig was running about 100 watts inupt. We had a nice chat of 15 to 20 minutes with absolutely no signal difficulties on either end. Immediately upon signing the W2 was called by a K6 located about three miles from my QTH. The K6 said he was running the proverbial California kilowatt into a cur-

Antenna Length (wavelengths)	Power Gain	Ø of Max Radiation
1	1.2	54 degs
2	1.4	36
4	2.1	25
6	3.1	20
8	4.3	18
10	5.6	17
12	7.2	16

Power Gain of Single Long Wire for Various Lengths

Fig. 2

rently popular tri-band beam (of the $200 class) with an advertised gain of about 8 db. Well, you've probably guessed the result. The K6 received the identical signal report that I did—Q5-S9. If we can assume identical efficiency in the two finals you can see that my Vee was giving me an 18 db gain. This is equivalent the 10 db difference in iput power plus the 8 db gain the tri-band beam should have. This 18 db is the theoretical maximum gain figure for the Vee with 10 wavelength legs, which is exactly what my Vee was. That is not bad performance from a $4.00 antenna! (The pitcher was free.)

Before you decide to rush out to the local hardware store for a handful of fish sinkers, it would be well to take stock of the amount of real estate under your control. A ten wavelength Vee for 15 meters is approximately 450′ long by 250′ wide at the widest point. That is a considerable chunk of real estate and not every one will have two and one half acres for antenna farming. On the other hand, most everyone (except apartment dwellers) will have room for an 80 meter dipole. The last part of this article will describe in detail the construction of a Vee antenna that will fit into the space normally required for an 80 meter dipole.

Although the intent of this article is to inspire you to build and enjoy the described Vee antenna, it is not recommended that you skip the following few paragraphs. These paragarphs deal with the theory of how a Vee works as it does and also list some alternate ways of squeezing the last db from the system.

Single Long Wires

A single long wire antena will exhibit "gain" compared to a half wave dipole. This is illustrated in Fig. 1. Note that the pattern in the plane of the one wavelength antenna is not concentrated broadside as in the case of a half wave dipole. Instead, the lobes of maximum radiation are at an angle of 54 degrees to the axis of the wire. Each of these lobes contain a greater concentration of energy than the lobes of the half wave dipole. Hence, the full wavelength antenna exhibits "gain" as compared to the dipole. The radiation pattern of a two wavelength antenna is shown in Fig. 1b. Notice that as in Fig. 1a the lobes of maximum radiation are not at 90 degree angles to the antenna axis. In fact, the lobes are much closer to the wire axis than in the one wavelength example. You can see then, that as the wire is made longer, the axes of the lobes of maximum radiation lie closer to the axis of the antenna itself. The power gain and the angle of maximum radiation for various lengths of single long wire antennas is listed in Fig. 2.

The Vee Antenna

A Vee antenna is a bi-directional antenna consisting of two horizontal wires arranged to form a V. In its unterminated configuration it is bi-directional; however, by terminating each leg in a non-inductive resistance of the proper value, one lobe can be eliminated for all practical purposes and the antenna will then radiate in only one general direction.

The process by which a Vee antenna provides gain is similar to that of a single long wire. The Vee will always provide more than two times the power gain of an equivalent length single wire. This is due to the interaction of the fields of each wire of the Vee upon the other wire, The method by which the Vee forms a bi-directional radiation pattern is illustrated in Fig. 3. The lobes produced by each leg of the Vee are designated as follows: on wire AA′, the lobes are numbered 1, 2, 3 and 4; on wire BB′, the lobes are numbered 5, 6, 7 and 8. When the proper angle Ø, called the apex angle, is chosen, lobes 1 and 4 have the

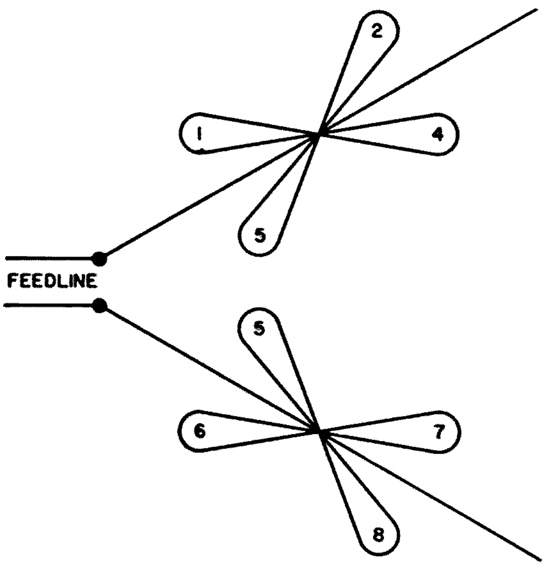

FIGURE 3
Lobe Patterns of a Vee Antenna

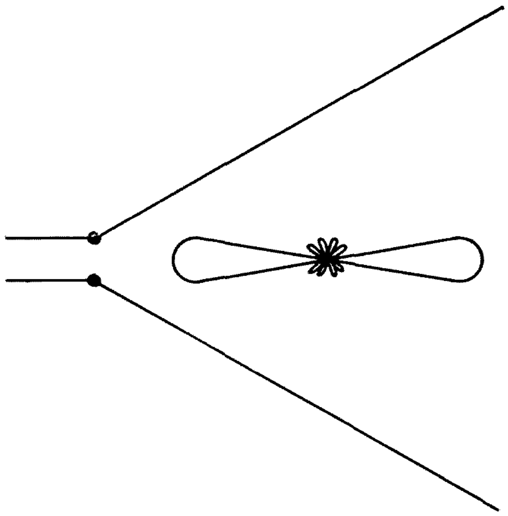

FIGURE 4

same direction and combine with lobes 6 and 7. This combination forms two stronger lobes that lie along a line bisecting the enclosed angle ϕ. Lobes 2, 3, 5 and 8 are largely cancelled since they are equal in amplitude, but opposite. There will be a certain amount of radiation broadside to the antenna due to minor lobes, but because of partial cancellation, these minor lobes will not be effective for long range communications. They are quite helpful however in short haul and local activity. The resultant radiation pattern for the Vee antenna is illustrated in Fig. 4.

As with other long wire type antennas the greater the leglength the greater will be the overall gain and directivity of the Vee antenna As mentioned previously the gain of the Vee is somewhat more than two times the gain of a single long wire of the same length due to the lobe combination and the interaction effects. The theoretical gain of the Vee for various leglengths is listed in Fig. 5. The actual length according to the published formula for determining wavelength is not at all critical within reasonable limits. The longer the leglength the less critical the actual length will become. If you use a length that is within 5% on a leglength of three wave lengths or more, there

Antenna Leglength	Power Gain
1	3.0
2	4.5
3	6.0
4	7.0
6	9.0
8	10.5
10	17.8
12	24.6

Power Gain of Vee Antenna
For Various Leglengths

Fig. 5

will be no noticeable difference. Although the general broad statement that "the longer the length the better" is valid, there is a point of diminishing return. Practically speaking, leg-lengths of more than 15 to 20 wavelengths will not provide a significant increase in gain. This is because of losses incurred in the longer lengths. Eventually a length will be reached where the losses will cancel any gain, resulting in nothing more than wasted wire. Although the author has not done any conclusive work in the VHF-UHF regions, it is possible that by counteracting certain types of losses, greater leglengths than mentioned above can be used . This will have to wait for the future.

Apex Angle and Vertical Radiation Angle

The optimum apex angle for the Vee is usually chosen as twice the angle between the lobes of maximum radiation and the wire axis. In practice a slightly smaller apex angle is used when the leglength is less than about three wavelengths. When the Vee is to be operated over a wide range of frequencies, the apex angle to be used is found by averaging the optimum angles for the frequencies involved. Reasonably good results are obtained if the optimum apex angles for the highest and lowest frequencies to be used are averaged. The optimum apex angle for various leglengths is shown in Fig. 6.

The Vee does not radiate the major portion of its energy along the surface of the earth. The maximum angle of vertical radiation depends on the length of the legs and the antenna height above the earth. Generally, as the height is increased or the leglength increased, the vertical angle of radiation becomes less. The effective vertical angle of radiation can be changed to practically any angle desired by tilting the antenna properly. For example, if you want a lower angle of vertical radiation than obtainable with your particular height and leglength combination, simply increase the height of the apex until the desired angle is obtained. This trick is more useful with the shorter leglengths since the apex height for a 10 wavelength Vee would have to be increased appreciably to make much of a change in the vertical radiation angle. However, this is not too troublesome since a 10 wavelength Vee will give you a vertical angle of approximately 13 degrees with the antenna horizontal. This angle is admittedly somewhat greater than optimum for one-hop DX, but usually will be more than adequate. The approximate angle of vertical radiation for various leglengths is also listed in Fig. 6. These angles are valid for an antenna height of one-half wavelength.

Antenna Leglength (wavelengths)	Optimum Apex Angle (degs)	Vertical Radiation Angle (degs)
1	90	31
2	70	27
3	58	23
4	50	20
6	40	16
8	35	14
10	33	13
12	30	12

Optimum Apex and Vertical Radiation Angles for Vee Antenna

Fig. 6

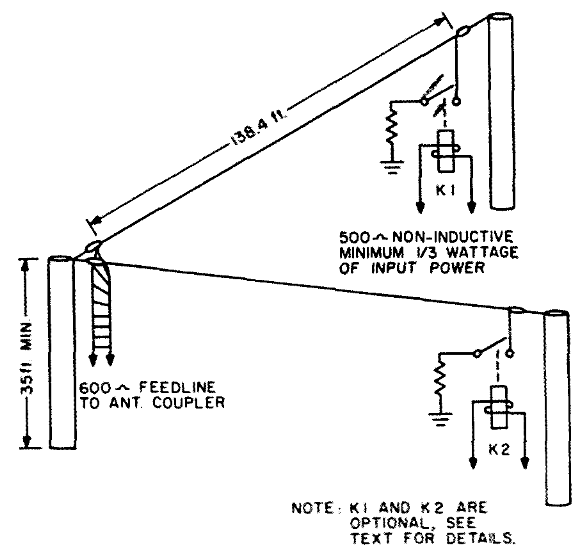

Figure 7

For Apex angle see Fig. 6

Radiation Pattern of Unterminated Vee Antenna

Band	Gain	Vert. Rad. Ø
80M	1 db	40 deg
40M	3 db	31 deg
20M	5 db	27 deg
15M	6 db	23 deg
10M	8 db	20 deg
6M	11 db	19 deg

Feeding the Vee Antenna

It is necessary to feed the two legs of the Vee antenna 180 degrees out of phase in order to set up the lobes as illustrated in Fig. 3. Balanced feedline should be used and if a wide frequency range is to be covered provision should be made to tune the feeders to the frequency in use.

Probably the simplest method of feeding the Vee is a 600 ohm resonant line which is attached to the apex of the Vee. If a non-resonant line *must* be used, a quarter wave matching stub is required. The Vee can also be fed at any point along either leg that is an odd number of quarter wavelengths from the open

end of the antenna. In this case a quarter wave stub must be connected to the apex and a "Q" bar matching section should be used at the feedpoint. It's obvious that frequency coverage will be limited in these cases.

Radiation Pattern and Directional Characteristics

In its unterminated configuration the Vee is bi-directional. It can be made uni-directional by properly terminating the free end of each leg in a non-inductive resistance. The actual value of the resistance will depend on too many variables to state an exact value here. Each individual installation will require a slightly different value somewhere between 400 and 800 ohms. Theoretically the value is 600 ohms, but due to ground conductivity, wire size, apex angle, height, frequency, and several other factors, it will change. The exact value required for your installation can be found by the trial and error method. Use the value that produces the lowest SWR for the frequencies involved. The resistance finally chosen should be capable of dissipating at least one third of the input power. A good ground consisting of 6-8 feet of one-quarter inch copper rod driven into the ground directly under the terminating resistors is very important. There are several other methods of making the Vee uni-directional, but limited frequency coverage and increased constructional difficulties limit the usefulness of these methods.

Practical Design for an All-Band Vee Beam

Now let's consider a practical design for an all-band Vee Beam. The first order of business should be a listing of the characteristics the antena will have. The following are considered to be minimum requirements:

1. It must be an all-band antenna.
2. It should exhibit as much gain as practicable.
3. It should be easy to feed and load on all bands.
4. It should be relatively easy to construct.
5. It should be as small as possible, consistent with good gain characteristics.
6. It should be as inexpensive as practicable.

An additional feature, although not required, is the capability to switch the beam directions, or, more properly, to attenuate signals from one direction. This feature will allow the QRM reduction so often wished for in working DX.

Once the features of our antenna are defined, we need to make several arbitrary de-

cisions. If DX is the major activity we will want to erect the Vee pointing the open end toward the DX areas. This will allow the beam to be switched to attenuate signals from directions opposite to the desired DX signals. This is true because the beam direction in the terminated configuration is toward the terminated ends. If, on the other hand, you are not particularly interested in DX, point the open end in the opposite direction. This way, if you should ever want to work DX, you need only to remove the terminating resistors and go to it. Remember, the unterminated Vee is bi-directional. Most hams (except apartment dwellers) will have the room required for an 80 meter dipole; therefore, this design is based on a leg-length that will fit into that space. As mentioned before, the half wavelength Vee theoretically is no better than a half wave dipole. In practice you will find that you will get better reports on 80 with a half wave Vee than with a half wave dipole. This is due to the partial combination of the major lobes even at this short leglength.

The pertinent dimensions and layout of the Vee are illustrated in Fig. 7. Before anyone notices, let me hasten to say that the apex angle indicated is not the same as the one that will result by averaging the highest and lowest frequencies. The angle indicated was chosen by the author to favor the 40 and 20 meter bands. If you have a different preference, by all means choose the apex angle that favors that band. To be sure, the other bands will not be optimum, but no all-band design will give perfect results on all bands.

The length indicated is calculated for 3.5 mc as the lowest frequency and, as stated, is not overly critical. The relays for switching the terminating resistors in and out are not required unless you want the luxury of beam switching from the operating position. If you do include them, be sure to adequately protect them from the elements and choose a relay that can handle at least 50% of the input power.

This is not an exhaustive treatise on Vee antennas. Unfortunately, space does not permit going into all the details of Vee design. Suffice to say that the author has a first-hand working knowledge of the Vee and as long as the real estate is large enough, there will never be a different kind at this QTH.

Coax Cable Losses

Most every serious or would-be serious VHFer knows by now that loss in the coax feedline to the antenna is one of the most insidious causes of poor station performance. But not so well-known are the maximum lengths of various kinds of cable usable to stay within specified loss figures on each of the VHF bands.

The accompanying chart shows the lengths, in feet, of the three most popular types of coax which produce the specified loss figures on the various VHF bands. For instance, on 144 lc the chart tells you that you will get I db of loss every 40 feet with the lowest-loss cable listed, which is RG-11. You get nearly 20 percent greater loss with RG-8, which gives 1 db of loss every feet.

Not listed are the newer "polyfoam" type of cables, since accurate loss information on them is slow in becoming available for calculations. One manufacturer has advertised his as having 35 percent less loss than RG-8; a bit of figuring shows that this probably means the losses are 65 percent as great, so you should be safe in using 1½ times as long a run of this cable as the listing shows for RG-8 on any given band.

. . . K5JKX

Table I—Lengths of Coax for Specified Cable Losses (in feet)

FREQUENCY In Mc	**TYPE** of cable	**LOSS** 1 db	2 db	3 db	4 db	5 db
50	RG-11	80	160	240	320	400
50	RG-8	67	133	200	267	333
144	RG-11	40	80	120	160	200
50	RG-58	33	67	100	133	167
144	RG-8	33	67	100	133	167
220	RG-11	31	62	93	124	155
220	RG-8	27	54	81	108	135
432	RG-11	21	42	63	84	105
144	RG-58	18	36	54	72	90
432	RG-8	17	34	51	68	85
220	RG-58	13	27	40	54	67
432	RG-58	9	18	27	36	45

The ON5 and PA9 Operation

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How it All Began

Ever since my wartime experience of Mobile operation in the Army, I have always been interested in Mobile operation. Thus, when early in 1962 I heard ON4PL Mobile on 80-metres, I naturally wanted to contact him and we had a pleasant QSO.

In May of that year I had to go to Belgium on a business trip, and so I decided to spend the weekend visiting ON4PL—Leon Peters. I had a very, very pleasant reception from him and his family who entertained me with a magnificent dinner well into the night after showing me all round the district, particularly the Barrage of Eupen where he had been operating Mobile when I worked him.

During the course of the evening we naturally discussed Mobile operation and he asked me what I though of the idea of organising a Mobile Rally at Verviers. He pointed out that Verviers was only a few miles from the German frontier and also from the Dutch frontier, so he felt that one could really organise an International Mobile Rally—certainly it was no distance for the Dutch stations to come, or for the Germans.

"Did I think any British stations would come to such a Rally?" I am afraid I replied emphatically "No," as, I pointed out, I thought it very unlikely that we would be able to get a license to operate in Belgium because we do not grant reciprocal licensing facilities to other countries. The Dutch and Germans would probably be allowed to operate in Belgium, but I could not see the fun for a lot of English stations to come over merely to watch.

After a little pause, Leon replied—"But supposing I could get you licenses to operate, do you think the British would come then?"

This changed the picture entirely and I enthusiastically replied—"In those circumstances I cetrainly think British stations would come."

And Here the Matter Rested

In the autumn of 1962, I got a letter from Leon saying that he was pretty confident that he could arrange for the British stations to be permitted to operate on the day of the Rally. I am afraid that I replied that I doubted if many British stations would go to the expense and trouble of taking their cars across to Belgium to operate for one day only. Naturally, Leon thought I was being very greedy but, nevertheless, with his typical indefatigable spirit he plunged once more into the fray and asked what would be the minimum period which I thought would attract British participants to the Rally. I suggested a week.

Towards the end of 1962, Leon again wrote that he was now confident that he could get us the licenses to operate in Belgium for about a week, that the date of the Rally had been fixed for the 28th April and that he anticipated that he would get the licenses from the 26th April until the 3rd May. This was highly satisfactory. I wrote back enthusiastically welcoming the idea, and said I would do my best to encourage a British contingent to go to the Rally.

At this stage I felt safe in telling the R.S.G.B., the Amateur Radio Mobile Society, ARRL and various magazines, with a view to giving the matter some publicity.

Although no firm details were yet available A.R.M.S. published the onnouncement in "Mobile News" and said they would give further details when they were available: other Journals also mentioned it.

ON4PL co-operating closely with ON4VY, President of U.B.A. and SWL Julian Counhaye, then put in some magnificent work and the whole matter was finalised, so that applicants from any country could get a Mobile Belgian License for this period on application being made to—ON4VY, Calls issued being in the ON5 series.

We are indeed indebted to the tremendous work and energy which these gentlemen put in to the operation.

I then did all I could to give the operation the maximum publicity. I naturally informed the R.S.G.B., through the Editor of their Mobile Column: I informed the Short Wave Magazine, and I wrote to the ARRL, CQ Magazine and 73 Magazine.

At this stage no exact detailed information was available but I wanted to get this first International Mobile Rally as much publicity as possible.

Later on I received copies of the full details of the Rally from ON4PL in French. I had a quick translation made and forwarded the original French version with the translation to the Mobile Column of R.S.G.B., A.R.M.S., Short Wave Magazine, CQ Magazine, 73 Magazine, the Irish Radio Transmitters Society, A.R.R.L. and as many other people as

I could think of, while also discussing it freely over the air.

As soon as it became clear that our operations in Belgium would be permitted, we decided to try and get Licenses in other countries also.

I wrote to Austria and received a very polite letter informing me that the Austrian regulations only permitted the issue of temporary Austrian licences to citizens of countries who granted similar facilities to Austrian nationals. They pointed out that no reciprocal agreement had been signed with Britain but added that if I could show *in practice* this facility was available even without an official agreement being in existence they would still be prepared to grant me a temporary licence. Unfortunately, of course, this facility is not available and, therefore, no Austrian licence was obtained.

Others made application for German licences and these were also not forthcoming.

I wrote to the Secretary-General of R.E.F. in France on the same basis and received again a very polite reply that since no agreement existed between Britain and France no licence could be granted to a British Subject. He added, that in the event of such a proposal being put forward by Britain he had little doubt that the French Government would be prepared to grant licences to British Subjects on a reciprocal basis.

Meanwhile, the Secretary of A.R.M.S., G3FPK, had got into contact with PAØZD and discussed the question of obtaining a Dutch licence in connection with the Verviers Rally. The suggestion was made that a block application should be made officially by A.R.M.S., through PAØZD, to the Dutch authorities. This, accordingly, was undertaken by A.R.M.S. who submitted the names, Call signs, etc. of all British Amateurs who wished to try and obtain Dutch licences, together with photostatic copies of the British licences.

This was the first time that A.R.M.S. has dealt officially with a Government Department, and all Members of the A.R.M.S. were naturally very interested to see whether this new departure of a joint application made by A.R.M.S. would bear fruit.

We are much indebted to Dr. Ten Herkel, PAØZD, for his efforts in this connection which resulted in our obtaining temporary Mobile licences to operate in the Netherlands from the 20th April until the 5th May.

We were allotted the special Call Sign of PA9 followed by the same letters as those which follow the figure in our own Call Sign.


One of the 80 metre capacity hats

So, all was set for the Operation ON5 and PA9! !

The Event Itself

Now that we had licences to operate in Belgium and Holland, I was not going to waste any time.

On the evening of the 20th April I flew over to Holland, using the air ferry service from Southend to Rotterdam. Unfortunately, I could not get an earlier plane and we landed in Rotterdam in the evening. I had selected a quiet hotel in the North of Holland—The Hotel Bellevue at Egmond-Aan-Zee, and had reserved rooms in advance. This was important because normally this is the Dutch Bulb Season and the hotels in Holland, particularly Rotterdam and Amsterdam, are very full at this time of year.

We arrived on the evening of the 20th April and went on the air, but without much success that evening. We operated intermittently from then on throughout the period.

The first weekend, the 20th and 21st, was very difficult because of the R.E.F. Contest. Nevertheless, we did achieve some entertaining contacts; On Monday I worked a couple

DL1KN with hat

of VKs. We operated around northern Holland, drove over the dyke which has been built across the north of what was once the Zuider Zee, and now called the "Ijselmeer."

The operation was interrupted for a couple of days while we went to Brussels on a business visit and the Belgium licence had not yet become effective.

We had the opportunity while in Brussels of making the acquaintance of ON4VY, the President of U.B.A. (the Belgian National Association) who had put in such tremendous work to obtain the Belgian Licenses for us. I was delighted to have the opportunity to meet Rene and his wife. Unfortunately, they could not dine with me that evening as they had other arrangements but they showed us a delightful little restaurant in Brussels where we had one of the most outstanding meals of the trip. Rene also showed us the official Station of U.B.A. which is situated in the headquarters of the Red Cross Society, with a magnificent view from the roof of the building.

On the morning of Friday, the 26th April, we moved off from Brussels and made a number of contacts, including some very entertaining ones while moving fast down the road from Brussels to Namur. I knew of a spot with a magnificent view over the River Meuse which I had visited the year before and which seemed to me to be a very good location to do some more transmitting. This spot is about half way between Namur and Dinant high up on a ridge above the little town of Profondeville.

The weather was now somewhat misty and we did not have much of a view "optically" but we did have quite a good view from a radio point of view, and work 9Q5 and 5N2 as well as a number of European stations. From here we went on to Verviers. We wanted to arrive early in order to meet everyone on the day before the Rally.

On Saturday, the 27th, we worked a bit of DX before breakfast, and were very glad to hook up with my very good friend, CN8BB, Roger Davize of Marrakech. He had, by the way, been my first contact with a Call of PA9BID/M, so I was very glad to work him from ON5ZE/Mobile.

We joined Leon Peters, ON4PL, during the morning, went for a tour of the town and arranged to lunch with his XYL, but just as we were returning to lunch we gave a CQ Call and another ON5/Mobile in Verviers came back to us. He was one of the American contingent from Germany who had arrived early. We found his QTH and immediately drove to meet him. He was DL4HU: he was on his own and we took him along to the house of ON4PL. Unfortunately, he had already had lunch but he sat and watched us consume an excellent lunch with ON4PL and his wife.

In the afternoon we went for a run and met all the local radio amateurs in the Verviers area as well as the SWLs who had put in a tremendous amount of work organising the Rally.

Saturday had been brillantly fine and sunny, and we all listened with interest to the weather forecast which promised the same weather for the Sunday, after clearance of early morning mist. The only part of this forecast which proved accurate was the early morning mist. We woke on the Sunday to find the mist covering the whole countryside: it never cleared. The mist developed into a drizzle, and the drizzle became a downpour: the weather got worse and worse.

The actual Contest for the Rally took place from 8-11 o'clock in the morning when all the Mobile stations worked the static stations in the Verviers area as well as any other Mobile stations. One was allowed to contact each of the fixed stations once every 25 kilometres. Activity took place on 80-meters and 2-metres. I myself operated on 80-metres. Soon the 80-metre Band was fairly crowded, particularly at the low end around 3.6 megacycles which, by the way, is where the Belgian 80-metre operators congregate. The Mobiles were either approaching Verviers from a distance or, in most cases, cruising round and round Verviers in circles, making the maximum number of contacts, and at 11 o'clock all the Mobiles concentrated at the Park de la Tourelle in Verviers.

Many countries were represented besides the Belgians. There were representatives from France, Germany (both German nationals and Americans and British operators from Germany), Holland and Britain. The British con-

tingent was quite numerous, numbering between 17 and 20 Mobile vehicles.

The amazing array of 2-metre Antennas which were seen was one of the features. 3 and 4-element 2-metre beams were quite usual amongst the 2-metre Mobile contingent usually mounted on the roofs of their cars, while the 80-metre Mobiles had all sizes of capacity hats, loading coils, etc.

The instructions for the Rally had suggested a picnic lunch, and this we had prepared but, unfortunately, the drizzle had by now become a downpour making the picnic somewhat difficult, and most of the operators decided to eat in the Verviers Hotels and Restaurants.

After lunch, the Rally organisers had prepared a tour of the district starting at Verviers and ending at the Barrage of Eupen. A detailed route card in the form of a questionnaire, asking such questions as the type of Antennas seen on various houses, the lengths of certain long wires which were passed, the age of various village pumps, was designed to show us the most attractive parts of the district. Unfortunately, the weather was so much against this, the visibility was becoming worse and the rain continued, that many operators including myself, got lost early in the route and decided to make straight for the Barrage of Eupen. Here a large restaurant with magnificent parking accommodation was available, and we used the refreshment facilities. The Rally organisers had arranged a seperate room and here we all assembled for the prize-giving. The people of Verviers had been most generous and an enormous number of magnificent prizes were offered by the people of Verviers and the Rally organisers.

One prize was offered from America—a Mobiliers Microphone—by W8OVJ.

So ended the Rally itself which had been a most enjoyable experience despite the efforts of the weather to spoil it.

I had the pleasure that evening of having

One of the cars with 2 and 80 metre antennas

ON4PL at the mike with ON4VY behind

Mr. Rene Vanmuysen, ON4VY, and his XYL, Leon Peters, ON4PL, and his wife, Vic Frisbee, G3KVF, (who also had an ON5 Call) and his wife and daughter, to dinner at Tiegelez-Spa, and we were able once again to thank ON4PL and ON4VY for their tremendous assistance in this matter. I am glad to say both have been made Honorary Members of the A.R.M.S.

We sincerely hope that the Rally organisers will see fit to repeat this performance on another year.

Although the Rally itself was now over, the Licenses, thanks to the generosity of the Belgian and Dutch postal administrations, still continued, and these I did not intend to waste.

I had a business visit to make in Luxembourg but, unfortunately, the authorities in Luxembourg had not prepared to grant Mobile Licences. We, therefore, made our visit to Luxembourg as short as possible, and returned to Belgium to continue our operations. We continued to Northern Belgium and then into Holland, and the operations from ON5ZE/Mobile and PA9B1D/Mobile did not finish until the evening of the 5th May when I got the car air ferry back from Rotterdam to Southend.

Not only did we enjoy working from a different country and also working some quite entertaining DX, including PY7AKW in Fernando Noronha, and an aeronautical Mobile, K1SDS/AM, but perhaps one of the most pleasurable parts of the whole operation was contacting and meeting personally the radio amateurs of Belgium and Holland.

Besides the Belgian amateurs whom I have mentioned earlier, we also had the pleasure of meeting a number of amateurs from the Netherlands, PAØCS talked me in to his QTH in the Hague from Lisse on 80-metres, and we very much enjoyed the visit to his shack where we met his family and went to lunch at Scheveningen.

Dr. Hans Ten Herkel who had succeeded in obtaining the Licences for us in the Netherlands was not in the Hague himself at that time, but, fortunately, we were able to meet him later when he joined us in Rotterdam, and we very much enjoyed the visit.

Both PAØCS, Kees de Bruijn, and PAØZD, Hans Ten Herkel, are coming to the Sideband Dinner. I am glad to say that Dr. Hans Ten Herkel has also been made an Honorary Member of the A.R.M.S.

To round off my visit I returned to Egmond-Aan-Zee, and here again I met more local amateurs.

PAØJKO who only works on 2-metres saw my aerial and invited me to his shack where I met his wife and saw his charming home.

I also heard PAØUX who lives in Alkmaar, and I also had the pleasure of visiting him and his wife.

So ended a memorable and most enjoyable 2 weeks operation with new Call Signs in countries where we had never operated before.

. . . G3BID

Letters

Dear Wayne:

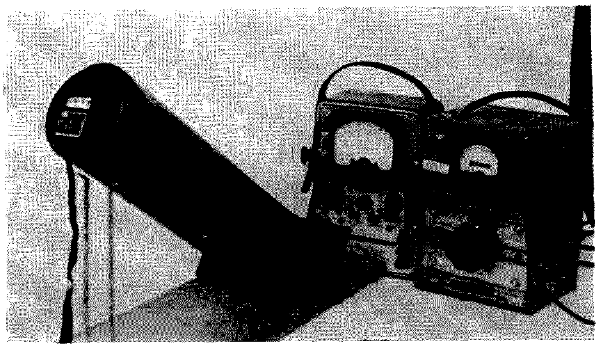
Being a new reader of 73, I just ran across this Double Sideband article. Without getting into personalities and it is a little hard not to do, I would like to point out just one discrepancy. As a writer you know how easily it is to slant the arguments the way the writer feels, quote out of context and etc. A good portion of the "gain" of DSB over SSB was supposed to be obtained by processing the speech input, i.e. clipping, compressors and etc., something the supposedly can not be done with SSB! Bell Labs apparently never heard of this "fact" as there are thousands of phone calls going on over compressed SSB this minute! Wes Schum, W9DYV told me a number of years ago he had heard of this "fact" but that it was like the bumble bee who didn't know he wasn't able to fly. So Wes put a very nice clipper-limiter in his 100V-200V transmitters. I could also mention the thousands of Collins SSB transmitters in amateur, commercial and military service with their ALC which gives 10-15 DB of compression or adds that much to the signal however you want to look at it. I always like to advocate ALC when I get a chance because I know how easy it is to drive the average ham SSB transmitter into flat topping and distortion without it. It is very easy to add to many transmitters in use with only a few parts and no adjustments. This would be a good kit for you to handle. Speaking of your kits, I think it is a most excellent idea. It is impossible to find all the parts to build even the simplest project except in maybe 3 or 4 major centers in the country. Maybe this will promote a little more home construction. There are too many plug-in appliance operators now. I wish you lots of success. And don't let me forget to congratulate you and the XYL on the new arrival.

Wayne W. Cooper, K4ZZV/W6EWC

a cardboard mailing-tube

R F Wattmeter

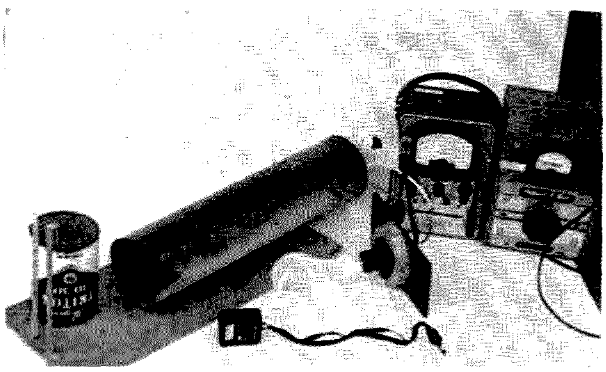
Bob Boird W7CSD



Hams since the year one have been connecting light bulbs up to the transmitter and giving them the old eye-ball. "Yup it looks like the rig is puting out about 100 watts" you'll hear them say. When you get right down to it the light bulb isn't such a bad idea. But the eye-balling leaves much to be desired unless you just like to kid yourself. Here's a way to get a little bit of accuracy out of the old light bulb.

All you need is a light bulb, a photographic exposure meter, and something to cover the two up with. The illustrations show what this writer came up with. In our case we used a 200 watt light bulb and a very old exposure meter that had been lying around a long time. If your rig is smaller and you have a brand new exposure meter, possibly a 50 watt light bulb and a shoe box will do as well. A little bit of trial and error is in order.

Once you have the right combination of light bulb and length to go with your rig and exposure meter the meter can be calibrated in watts. This is done simply by connecting the bulb thru a wattmeter (or volt and ammeter) to a variac or other adjustable voltage source. Adjust the voltage to minimum reading on the exposure meter and read the wattmeter. Adjust again for slightly greater readings and so on until you arrive at full voltage. Plot watts vs. exposure meter reading on a piece of graph paper and you are in business. When the light bulb is connected to the transmitter the degree of brilliance will now register on the exposure meter and you can transpose on your graph and get a resonably accurate reading in watts.



The model pictured uses a 22 inch mailing tube about three inches in diameter inside. The light socket is mounted on a piece of wood jigsawed to just fit inside the mailing tube. This assembly is backed up with a rectangular piece of masonite on the end. The next problem was to find a satisfactory end that could have a windowfor the exposure meter cut in it. It just happened that the oil can appearing in the illustration made a perfect fit after the rim was removed with a pair of tin snips. It might be in order to note that Royal Triton oil cans are made of aluminum, in case you have need for aluminum shielding for other purposes. In this case a fruit can of the proper size would have done just as well. The standard supporting the assembly was strictly an afterthought. You could use a stack of books or anything else convenient. Sloping the tube does make for easier reading of the meter and in our case the meter would stay in place due to its own weight when the tube was in the sloped position.

. . . W7CSD

Transceiving Complicated

Larry Levy WA2INM/1
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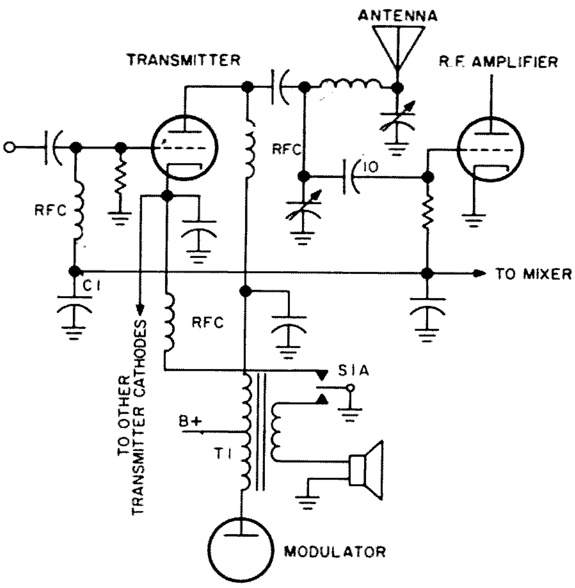
Marlboro, Vermont

I have just finished reading an article by Dean Cupp W4JKL (73, Nov. 1962, p. 65) about transceiving, and would like to expand somewhat upon some of his ideas. To start with, most transceivers in use use a 4 pdt switch or relay for function switching. One pole switches the audio, another the speaker, another the B supply, and the fourth the antenna. This can be simplified somewhat, so the function switching can be accomplished with a dpdt switch. With the proper circuitry, B supply switching can be eliminated, as well

as antenna switching, leaving speaker and audio input. Referring to Figl, the antenna is connected to the transmitter tank circuit only. A small condenser is connected between the plate side of the final tank circuit and the receiver input, on the assumption that if the tank is tuned to match impedance to the transmitter, it will also do a reasonably good job for the receiver. In practice, this works quite well. We have now eliminated one pole of the switch. Read on, and you will see what other foul and devious means are used to eliminate the other. The negative bias of the final amplifier is used to bias the rf amplifier and mixer to cutoff during transmit, as described in W4JKL's article. The cathodes of the transmitter tubes are connected together and wired to one side of one of the poles on the switch. The center contact is grounded, and the other side is connected to the speaker return. At this point, all of the necessary control functions are accounted for, with the exception of the audio input switching, for which the other pole of the switch is used. By using these methods, the number of switch poles has been reduced from 4 to 2 while performing the same functions. This should make it possible to use inexpensive dpdt relays for PTT control of compact transceivers, where two of these relays occupy too much space, and a 4pdt relay is too expensive. If PTT is not desired, the TR switch can be a dpdt switch mounted on the front panel. Alright, you've wasted enough time reading cacography like this, so drag out your soldering gun and start building. . . . WA2INM



T1 - TRANSCEIVER TYPE MODULATION TRANSFORMER
FIGURE 1

Transmitting Tube Guide

TUBE TYPE	CLASS OF TUBE	PWR DISS WATTS	FREQ OF MAX RATING	MAX USABLE FREQ	MFR.	FIL./HTR. VOLTS	FIL./HTR. AMPS	CAP IN MMFD	CAP G-P MMFD	CAP OUT MMFD	MAX. HGT. IN.	MAX. DIA. IN.	TYPE OF OPERATION	OP. FREQ MC.	PLATE VOLTS	PLATE CURR. MA.	SCRN VOLTS	SCRN CURR. MA.	GRID BIAS VOLT.	GRID CURR. MA.	RF DRIVE VOLTS	DRIVE POWER WATTS	LOAD IMP OHMS	3RD ORDER DISTORT	PLATE PWR OUT WATTS	
2C39A	UHF Triode	100	2500		ERS	6.3	1.0	6.6	2	.035	2-3/4	1-1/4	Class C	2500	900	90			-22	27	X	X	5000			17
													Class C	300	900	90			-40	30	X	X	5000			40
2C39B	UHF Triode	100	2500		GS	6.3	1.0	7	1.9	.035	2-3/4	1-5/64	Class C	500	900	90			-40	30	X	(osc.)	5000			40
2C40	UHF Triode	6.5	3370		RS	6.3	.75	2.2	1.3	.03	2-9/16	1-5/16	Class C	X	250	20			-5	.3	X	X	6250		.075	
2C43	UHF Triode	12	1500		GS	6.3	.9	3	1.8	.04	2-11/16	1-5/16	Class C	300	350	48			-50	40	X	3	3650		10	
2E22					T																					
2E24	Fil Beam	13.5	125	175	GRS	6.3	.65	8.5	.11	6.5	3-21/32	1-5/16	Class C	125	600	66	195	10	-50	3	71	.21	4570		27	
													Class C	160	350	85	170	10	-50	3	70	2	2075		16.5	
2E26	Beam	13.5	125	175	GRS	6.3	.8	13	.2	7	3-21/32	1-5/16	Class C	125	600	66	185	10	-45	3	57	.17	4570		27	
													Class C	160	350	85	200	7	-90	3	105	2	2075		16.5	
2E30	Fil Beam	10	165		G	6	.65	9.6	.11	14	2-5/8	3/4	Class C	165	300	50	250	5	-70	.7	75	1.7	3000		6	5
													Linear	X	250	20160	250	2/10	-30	1.15	87	.1	1900	X	8.5	
3-400Z	Triode	400			E								Linear													
3-1000Z	Triode	1000			E								Linear													
3A4	Fil Pent	2	10		RS	2.8/1.4	.1/.2	4.8	.34	4.2	2-1/8	3/4	Class C	X	150	18.3	135	6.5	-26	.13	X	X	4100		1.2	
3A5	Fil Tw Tri	2	40		RS	2.8/1.4	.11/.22	.9	3.2	1	2-1/8	3/4	Class C	X	135	30			-20	5	90	.2	2250		2	
3C22	Triode	125	1400		GR	6.3	2	4.9	2.4	.05	4-15/16	1-1/2	Max	X	1000	150			-200	70	X	X	X		X	
3C24					E																					
3CX100A5	UHF Triode	100			ES								Class C	X												
3E22	Twn Beam	35	15		R	12.6/6.3	.8/1.6	14	.22	8.5	4-9/16	2-1/16	Max	X	600	175	225	6W	-175	11	X	X	X		X	
3E29	Twn Beam	15	X		R	12.6/6.3	1.125/2.25	14	.12	7	4-5/16	2-3/8	Max	X	5000	300	850	3W	-225	1W	X	X	X		X	
4-65A	Beam	65	150		EPRS	6	3.5	7.5	.08	2.2	4-3/8	2-3/8	Class C	X	3000	115	250	22	-100	10	170	1.7	13000		280	
4-125A/4D21	Beam	125	120	240	AEGPRS	5	6.5	11	.05	3.2	5-5/8	2-7/8	Class C	X	3000	167	350	30	-150	9	280	2.5	9000		375	
													Linear	X	3000	28/130	350	0/3.5	-51	X	99	2.5	13850	X	260	
4-250A/5D22	Beam	250	75	120	AEGRS	5	14.5	13	.12	4.6	6-3/8	3-9/16	Class C	X	3000	345	500	60	-180	10	265	2.6	4350		800	
													Linear	X	4000	40/165	510	X/7.5	-100	0	100	0	X	X	450	
4-400A	Beam	400	110		AEPRS	5	14.5	13	.12	4.6	6-3/8	3-9/16	Class C	X	3000	350	500	42	-220	19	320	X	4400		800	
													Linear	X	4000	60/293	750	0/20	-150	0	148	0	7250	X	775	
4-1000A	Beam	1000	110		EPRS	7.5	21	28	.26	8	9-5/8	5-1/4	Linear-Max	X	6000	700	1000.	75W	X	X	X	X	X	X	X	
4C33	Triode	250	625		R	5	9.1	34	13	.7	4-7/8	2-1/16	Max	X	13000	30			-2000	4	X	X	X		X	
4CN15A	Beam				E																					
4CX125C	Beam				E																					
4CX250B	Beam	250	500		AES	6	2.6	15.7	.06	4.5	2-15/32	1-41/64	Class C	175	2000	250	250	19	-90	26	112	2.9	4000		390	
													Linear	175	2000	75/250	300	01-7	-47	-1/0	47	0	4200	-32	300	
4CX1000A	Beam	1000			E																					
4E27/8001	Beam	75	75		R	5	7.5	11	.06	4.6	6-3/16	2-11/16	Max	X	4000	150	750	30	-500	25	X	X	X		X	
4E27A/5-125B	Beam	125	75		EPRS	5	7.5	11	.08	4.8	6-3/16	2-1/16	Class C	X	3000	163	500	20	-200	6	190	1.6	9200			325
													Linear	X	2500	35/165	750	.2/19	-134	0	134	0	X	-25		265
4W300B	Beam	300	500		AES	6	2.9	17.2	.06	5	3-9/16	1-9/16	Same as 4CX250B Except Water-Cooled													
4X250B	Beam	250	500		AES	6	2.6	15.7	.06	4.5	2-15/32	1-21/32	Same as 4CX250B													
4X500A	Beam	500	120		AEPR	5	13	14.4	.1	6.9	4-5/4	2-5/8	Class C	X	3000	310	500	24	-150	16	230	5	4900		600	
6C24	Triode	600	160		R	11	12.1	4.6	4.4	3.2	8-23/32	1-29/32	Max	X	3000	500			-500	150	X	X	X		X	
6F4	Triode	2	1200		R	6.3	.225	1.9	1.8	0.6	1-3/8	21/32	Max	X	150	20			-50	8	X	X	X		X	
7C29	Triode	500	110		G	10	25.5	10.2	7.6	.45	5-3/8	2-1/2	Class C	110	2800	330			-250	75	X	X	4270		600	
10Y	Triode	15	8		R	7.5	1.25	4	7	3	5-3/8	2-1/16	Max	X	450	60			-200	15	X	X	X		X	
25T	Triode				E																					
35T	Triode				E																					
35TG	Triode				E																					
75TH	Triode				E																					
75TL	Triode				E																					
100TH	Triode	100	X		EGS	5	6.3	2.9	2	.4			Class C	X	3000	165			-200	51	385	18	9000		400	
													Linear	X	3000	20/108			-65	X	165	5	15500	X	325	
100TL	Triode				E																					
152TH	Triode				E																					
152TL	Triode				E																					
PL175A	Bm Pentode	400	110		P	5	14.5	15.1	.06	9.8	6-5/8	3-9/16	Class C	X	3000	350	600	36	-180	6	218	1.3	4400		786	715
													Linear	X	3500	75/350	750	1/24	-180	0	160	0	X	-31	869	790
PL177A	Bm Pentode	75	175		P	6	3.2	7.5	.06	4.2	4-3/8	2-3/8	Class C	X	2000	150	400	12	-125	5	165	.8	6600		250	220
													Linear	X	2000	25/175	600	0/7	-115	0	112	0	X	-30	225	210
PL177WA	Bm Pentode	75	175		P	6	3.2	7.5	.06	4.2	4-3/8	2-3/8	Ruggedized, otherwise identical to PL-177A													
HF200	Triode	150	30		A	10-11	4	6.2	6.9	1.2	10-1/4	5-3/4	Class C	X	2500	200			-300	18	455	8	6250		380	
													Linear	X	2500	90 car.			-140	0	130	4	X	X	320	
HF201A	Triode	150	30		A	10-11	4	6.8	7	1.2	10-7/8	3-1/16	Class C	X	2000	160			-350	20	500	9	6250		250	
													Linear	X	2500	30/180			-130	X	230	4	X		300	

Transmitting Tube Guide

TUBE TYPE	CLASS OF TUBE	PWR DISS WATT	FREQ OF MAX RATING	MAX. USABLE FREQ	MFR.	FIL/HTR VOLTS	FIL/HTR AMPS	CAP IN MMFD	CAP G-P MMFD	CAP OUT MMFD	MAX HGT IN.	MAX DIA IN.	TYPE OF OPERATION	OP FREQ MC	PLATE VOLTS	PLATE CURR MA.	SCRN VOLTS	SCRN CURR MA	GRID BIAS VOLT	GRID CURR MA	RF DRIVE VOLTS	DRIVE POWER WATTS	LOAD IMP OHMS	3RD ORDER DISTORT	PLATE PWR OUT WATTS	PWR IN LOAD WATTS
5618	Pent	5	100	165	R	6/3	.23/.46	7	.24	5	2-5/8	3/4	Max	X	300	30	125	2W	-125	3	X	X	X		X	
5675	Triode	9	1700		R	6.3	.135	2.3	1.4	.09	2-1/4	13/16	Class C	1700	120	25			-8	4	X	(osc.)	2400		.47	
5686	Beam	8.25	160		R	6.3	.35	6.4	.11	4	2-3/16	7/8	Class C	X	250	40	250	10.5	-50	2	75	.15	3330		6.5	5.25
5763	Beam	13.5	50	175	RS	6	.75	9.5	.3	4.5	2-5/8	7/8	Class C	30	350	48.5	250	6.2	-28.5	1.6	37	.1	3610		12	
5866	Triode	135	150	200	A	6.3	5.6	5.8	5.5	.1	5-3/16	2-7/16	Class C	X	2500	205			-200	40	390	14	6100		390	
													Class C (G-G)	X	2500	205			-200	40	[illegible]	79	6100		455	
													Linear	X	2500	30/178			-86	X		16	4550	X	350	
5867	Triode	250	100	150	A	5	14.1	6.3	5	.16	5-15/16	3-7/16	Class C	100	2500	400			-200	69	380	23.5	3130		750	
													Linear	X	3000	50/285			-110	75	232	16	3550	X	640	
5868	Triode	450	100	120	A	10	9.9	8	7	.17	8-3/8	4-21/32	Linear	X	3500	70/442			-114	115	282	29	2550	X	1220	
5876	Triode	6.25	3000		R	6.3	.135	2.4	1.4	.035	2-1/4	13/16	Class C	500	275	23			-51	7	X	2	6000			5
5893	Triode	8	2000		R	6	.28	2.4	1.7	.07	2-1/4	13/16	Class C	1000	350	35			-33	13	X	2.4	5000			6.5
5894	Twn Beam	40	250	500	ARS	12.6/6.3	.9/1.8	11	.08	3.4	4-5/16	1-15/16	Class C	250	750	180	250	14	-80	3.4	200	6	2080			96
													Linear	30	800	45/152	280	0/28	-29	0	29	0	X	-35	90	
5895	Fil Beam	8	186	300	A	6.3/3.15	.68/1.36	8.5	.05	3.3	3-15/16	1-9/32	Class C	X	600	60	200	3	-80	2	210	.2	5000		25	
6028	Triode	3	400		R	6.3	.2	2	1.3	.42	1-1/2	3/8	Class C	400	135	20			-26	20	X	(osc.)	3370			1.25
6079	Beam	500	75	100	A	10	9.9	24	.25	8.3	8-1/4	4-21/32	Linear	X	4000	75/370	600	1/26	-51	21	150	3.15	6300	-35	1032	
6083	Pent	45	60		A	12.6	1.35	24	.2	12.2	4-11/32	1-15/16	Class C	X	1000	177	250	28	-120	5	144	.65	2850		132	
													Linear	X	1000	20/138	300	1/18	-37	2	48	.08	4000	-32	92	
6146	Beam	25	60	175	AGRSTW	6.3	1.25	13	.24	8.5	3-13/16	1-23/32	Class C	X	750	120	160	11	-62	3.1	79	.2	3130		70	
													Linear	X	750	12/110	195	.5/13	-50	0	50	0	4000	X	60	
6155/4-125A	Beam	125	120	250	AR	5	6.5	10.8	.05	3.5	5-1/16	2-7/16	Class C	X	3000	167	350	30	-150	6.5	X	2	8900		375	
													Linear	X	3000	23/115	600	2/14	-108	0	108	0	15000	-30	228	
6156/4-250A	Beam	250	75	120	AR	5	14.1	13	.14	4.6	5-1/16	3-27/64	Class C	X	3000	345	500	60	-180	10	327	3.3	4350		800	
													Linear	X	4000	33/155	600	0/23	-120	0	120	0	14750	-30	421	
6161	Triode	250	900	2000	R	6.3	3.4	11	6	.22	3-13/32	1-3/4	Class C	600	1500	250			-150	50	200	75	3000			270
6252	Twn Beam	20	300	600	AT	12.6/6.3	.65/1.3	4.4	int. neut.	1.6	3-3/8	1-13/16	Class C	220	600	100	250	8	-60	1.4	X	1.5	3000		48	
													Linear	30	750	28/89	225	1/12	-26.5	0	25.5	0	4800	-30	43	
6263	Triode	13	500	1700	R	6	.28	2.8	1.7	.08	2-5/8	1	Class C	500	350	40			-58	15	X	3	4450			10
6264A	Triode	13	500	1700	R	6	.28	2.95	1.75	.07	2-5/8	1	Class C	500	350	40			-45	15	X	3	4450			10
6360	Twn Beam	14	200		A	12.6/6.3	.41/.82	5.1	int. neut.	1.4	3-1/16	7/8	Class C	X	300	100	200	3	-45	3	130	.2	6000			16
6417	Beam	13.5	50	175	R	12.6	.375	9.5	.3	4.5	2-5/8	7/8	EXCEPT FOR HTR, IDENTICAL TO 5763													
6524	Twn Beam	25	100	470	R	6.3	1.25	7	.11	3.4	3-9/16	1-11/16	Max	X	600	150	300	3W	-200	4	X	X	X		X	
PL6549	BM Pent	75	175		P	6	3.3	7.5	.09	3.4	4-3/8	2-3/8	Class C	X	2000	150	400	12	-125	5	165	.8	6600	G3=+70V	250	
													Linear	X	2000	15/112	400	0/5	-85	X	180	.05	9500	G3=+70V	163	
PL6569	Triode	250	60		P	5	14.5	7.6	(G-G) .1	3.7	6-3/8	3-9/16	Class C G-G	X	4000	250			-120	50	230	70	8000			820
													Linear G-G	X	4000	24/250			-150	42	205	60	X	X		800
PL6580	Triode	400	60		P	5	14.5	7.6	(G-G) .1	3.9	6-3/8	3-9/16	Class C G-G	X	3000	350			-90	82	215	87	4300			745
													Linear G-G	X	4000	40/300			-100	65	230	72	X	X		910
6816	Beam	115	2000		R	6.3	2.1	14	.065	4.4	1-7/8	1-5/16	Class C	1200	900	170	300	1	-22	4	X	5	2650			40
													Linear	X	850	40/100	300	0/10	-15	0	15	0	3500	X	40	
6850	Twn Beam	25	100	470	R	12.6	.625	7	.11	3.4	3-9/16	1-11/16	EXCEPT FOR HTR, IDENTICAL TO 6524													
6883	Beam	25	60	175	RS	12.6	.625	13	.24	8.5	3-13/16	1-23/32	EXCEPT FOR HTR, IDENTICAL TO 6146													
6884	Beam	115	2000		R	26.5	.52	14	.065	4.4	1-7/8	1-5/16	EXCEPT FOR HTR, IDENTICAL TO 6816													
6893	Beam	13.5	125	175	R	12.6	.4	13	.2	7	3-21/32	1-5/16	EXCEPT FOR HTR, IDENTICAL TO 2E26													
6897	Triode	100	2500		G	6.3	1.05	6.6	1.95	.035	2-3/4	1-1/4	Max	X	1000	125			X	X	X	X	X		X	
6907	Twn Beam	20	300	600	AT	12.6/6.3	.65/1.3	4.4	int. neut.	1.6	3-3/8	1-13/16	Class C	462	400	100	250	5	-50	1.4	X	3	8000		25	
													Linear	30	750	28/89	225	1/12	-26.5	0	25.5	0	4800	-30	43	
6939	Twn Pent	7.5	500		AR	12.6/6.3	.3/.6	6.4	.15	1.6	2-5/8	7/8	Class C	500	200	60	200	14	-20	1.5	50	1.2	6670		7.2	6
7004	Triode	300	175	900	A	3.4	19	9	4	.12	2-7/8	1-21/32	Class C	175	2500	260			-200	X	275	25	4800		475	
													Class C	900	1300	350			-60	X	X	X	1900		155	
7034/4X150A	Beam	250	150	500	AEGRS	6	2.6	16	.03	4.4	2-1/2	1-5/8	Class C	X	1250	200	250	20	-90	11	106	1.2	3150		195	
													Linear	X	2000	21/235	300	9	-50	0	50	0	4380	X	290	
7060	Tri-Pent	2.75	40		R	12-15	.28	Pent: 7.1	.044	2.5	2-3/16	7/8	Class C	(Pent) X	300	20	125	6	-11	1.6	X	.025	7500		3.5	
7094	Beam	125	60	175	R	6.3	2.85	19.5	.6	9.7	5	2-9/16	Class C Max	X	1500	340	400	20W	-300	30	X	X	X		X	
													Linear Max	X	2000	350	400	20W	-300	0	X	X	X	X	X	
7203/4CX250B	Beam	250	500		R	6	2.6	16	.03	4.4	2-7/16	1-5/8	Class C	175	2000	250	250	30	-90	11	109	1	4000		400	
													Linear	30	2000	83/250	350	15 av	-55	0	55	1	4350	-30		295
7212	Beam	25	60	175	RT	6.3	1.25	13	.24	8.5	3-13/16	1-23/32	EXCEPT for BASE & SHOCK RESISTANCE, IDENTICAL TO 6146													
7213	Beam	1500	1215		R	5.5	17.3	97	.17	16	3-1/4	3-3/4	Class C	600	1800	750	500	15	-30	40	X	50	1200		650	
7270	Beam	80	60	175	R	6.3	2.85	18	.4	2.34	4-3/4	2-1/16	Max	X	1350	340	425	20W	-300	30	X	X	X		X	
7271	Beam	80	60	175	R	13.5	1.25	18	.4	2.34	4-3/4	2-1/16	EXCEPT FOR HTR, IDENTICAL TO 7270													
7357	Beam	25	60	175	R	6.3	1.25	13	.24	8.5	3-13/16	1-23/32	EXCEPT FOR HTR, BASE, & SHOCK RESISTANCE, IDENTICAL TO 6146													
7360	Special	X	100		R	6.3	.35				2-5/8	7/8	Bal Mod	X	150	1.5	175	ED=25	Rk=1200	Eaf=2.8p-10			5000	-47	4 V p-p-	
7377	Twn Beam	16	1000		A	12.6/6.3	.3/.6	2.4	X	.8	2-1/2	1-3/4	Class C	960	250	80	170	15	-15	1.5	X	1.4	1560		8	5
7378	Beam	100	30		A	6.3	3.9	30	.9	12.7	5-5/8	2-3/4	Class C	30	750	385	250	20	-90	7	120	1	6200		200	
													Linear	X	750	73/435	310	2/38	-48	1.6	58	.09	1000	-27	228	
7527	Beam	400	110		A	5	14.1	12.7	.12	4.9	6	3-7/8	Class C	75	3000	350	500	30	-220	6	305	1.8	4350		800	
													Linear	X	4000	80/270	705	0/14	-130	0	130	0	9150	-35	723	
7551	Beam	12	175		R	12-15	.36	10	.15	5.5	2-5/8	7/8	Class C	175	300	80	250	5.1	-55	1.6	62	1.5	1880			10
													Linear	X	300	20/62.5	250	1/7	-21	0	20	0	2500	X	10	
7554	Triode	2.5	5000		R	6.3	.225	4.4	2.4	.04	1-1/2	9/16	Class C	1000	175	19			-10	5	X	.2	4600			1.4
7556	Beam	12	175		R	6.3	.8	10	.15	5.5	2-5/8	7/8	EXCEPT FOR HTR, IDENTICAL TO 7551													
7580	Beam	250	500		AER	6	2.6	17	.03	4.5	2-7/16	1-5/8	Linear	30	2000	70/350	400	16 av	-77	.05	77	1	3050	-21		400
7650	Beam	700	1215		R	6.3	7.85	66	.011	5.31	2-11/32	2-1/8	Class C	400	2250	450	400	7	-45	10	X	30	2500			650
													Linear	30	2500	160/500	450	2.5 av	-37	.05	37	1	2700	-36		680

Transmitting Tube

TUBE TYPE	CLASS OF TUBE	PWR DISS WATT	FREQ OF MAX RATING	MAX USABLE FREQ	MFR	FIL/HTR VOLTS	FIL/HTR AMPS	CAP IN MMFD	CAP G-P MMFD	CAP OUT MMFD	MAX HGT IN.	MAX DIA IN.	TYPE OF OPERATION	OP FREQ MC	PLATE VOLTS	PLATE CURR. MA.	SCRN. VOLTS	SCRN CURR MA	GRID BIAS VOLT	GRID CURR MA	RF DRIVE VOLTS	DRIVE POWER WATTS	LOAD IMP OHMS	3RD ORDER DISTORT	PLATE PWR OUT WATTS	PWR IN LOAD WATTS
203A	Triode	100	15	80	R	10	3.25	5.7	14	.4	7-7/8	2-5/16	Max	X	1250	175			-400	60	X	X	X		X	
204A	Triode	250	3	30	R*	11	3.85	12.5	15	.3	14-3/8	4-1/16	Max	X	2500	275			-500	80	X	X	X		X	
211	Triode	100	15	80	R	10	3.25	5.4	14	4.8	7-7/8	2-5/16	Max	X	1250	175			-400	50	X	X	X		X	
242C	Triode	100	6	30	G	10	3.25	6.1	13	4.7	7-7/8	2-5/16	Class C	X	1250	150			-225	20	375	7	4150		130	
													Linear	X	1250	10/150			-95	X	200	4	3800	x	100	
250TH	Triode				ES																					
250TL	Triode				E																					
PL254W	Triode	100	175		P	5	7.5	3.4	2.5	.43	7-1/4	4-3/4	Class C	X	4000	125			-260	30	450	12	16000		400	
HF300	Triode	200	20		A	11	4	8	7	1	10-3/8	5-3/4	Class C	X	3000	250			-400	18	590	16	6000		600	
													Linear	X	3000	30/225			-115	X	225	6.5	5000	X	390	
304TL	Triode				E																					
450TH	Triode	450	40		AE	7.5	12	8.8	5	.8	12-5/8	5-1/8	Linear	X	4000	75/335			-85	X	235	17	3200	X	900	
450TL	Triode	450	40		AES	7.5	12	6.8	4.5	.7	12-5/8	5-1/8	Linear	X	4000	75/335			-175	X	183	17	3200	X	900	
UE572	Triode				U																					
592/3-200A3	Triode	300	110		EG	10	5	4.2	3.7	.36	6	3-13/32	Class C	X	3000	320			-250	60	520	30	4700		680	
													Linear	X	3000	25/245			-90	X	270	10	6625	X	475	
750TL	Triode	750	40		AE	7.5	21	8.5	5.8	1.2	17	7-1/8	Linear	X	4000	125/475			-230	X	490	19	2120	X	1150	
800	Triode	35	60		R	7.5	3.1	2.8	2.5	2.8	6-3/8	2-11/16	Max	X	1250	80			-400	25	X	X	X		X	
801A	Triode	20	60	120	GRS	7.5	1.25	4.5	6	1.5	5-3/8	2-1/16	Class C	X	600	65			-150	15	260	4	4600		25	
803	Pent	13	30		GR	6.3	.9	12	.15	8.5	5-3/4	2-1/16	Class C	X	600	55	250	16	-53	2.4	165	.3	5450	G3=40V	23	
803	Pent	125	20	60	GR	10	5	17.5	.15	29	9-1/2	2-9/16	Class C	X	2000	160	500	45	-90	12	175	2	6250	G3=40V	210	
													Linear	X	2000	80 car.	600	20 car.	-40	3 car.	110	3	12500	G3=40V	212	
804	Pent	40	15	80	R	7.5	3	13	.03	14	7 11/16	2-1/16	Max	X	1250	95	300	15W	-300	15	X	X	X		X	
805	Triode	125	30	80	GR	10	3.25	8.5	6.5	10.5	8-1/2	2-5/16	Class C	X	1000	200			-150	40	235	8.5	3750		215	
													Linear	X	1500	115 car.			-10	15 car.	140	15	6400	X	230	
806	Triode	150	30	100	R	5	9.5	5.6	4	.4	10	3-13/16	Max	X	3000	200			-1000	50	X	X	X		X	
807	Beam	30	60	125	AGRS	6.3	.9	12	.2	7	5-3/4	2-1/16	Class C	X	750	100	250	8.	-45	4	65	.3	3750		54	
													Linear	X	750	15/120	300	.25/10	-35	X	48	.5	3650	X	60	
808	Triode	50	30	130	R	7.5	4	5.3	2.8	.25	6-1/16	2-3/16	Max	X	1500	150			-400	35	X	X	X		X	
809	Triode	100	60	120	GR	6.3	2.5	5.7	6.7	.9	6-9/16	2-7/16	Class C	X	1000	100			-75	25	160	3.8	5000		75	
													Linear	X	1000	20/100			-10	X	156	1.7	5800	X	72	
810	Triode	125	30	100	GR	10	4.5	8.7	4.8	12	8-3/4	4-1/2	Class C	X	2500	300			-180	60	350	19	8335		575	
													Linear	X	2250	100 car.			-70	2 car.	200	4	11250	X	300	
811A	Triode	65	30	100	GRS	6.3	4	5.9	5.6	.7	6-5/8	2-7/16	Class C	X	1500	173			-70	40	175	7.1	4400		200	
													Linear	X	1500	16/157			-4.5	20 av.	X	8	6000	-25		160
812A	Triode	65	30		GRS	6.3	4	5.4	5.5	.77	6-5/8	2-7/16	Class C	X	1500	173			-120	30	240	6.5	4400		190	
													Linear	X	1500	14/155			-48	X	270	2.5	6600	X	170	
813	Beam	100	30	120	GRS	10	5	16.3	.25	14	7-1/2	2-9/16	Class C	X	2250	220	400	40	-155	15	275	4	5100		375	
													Linear	X	2500	25/145	750	1/27	-95	0	90	0	9500	X	245	
814	Beam	60	30	75	GR	10	3.25	13.5	.15	13.5	7-11/16	2-1/16	Class C	X	1250	144	300	22 max	-300	10	222	3.2	4400		130	
													Linear	X	1250	60 car.	200	33 max	-35	X	56	.85	10500	X	120	
815	Twn Beam	25	150	225	GRS	12.6/6.3	.8/1.6	14	.2	8.5	4-9/16	2-3/8	Class C	X	500	150	200	17	-45	3.5	112	.18	6670		56	
													Linear	X	500	22/150	125	32 pk	-15	X	60	.36	8000	X	54	
826	Triode	60	250	300	R	7.5	4	3	3	1.1	3-11/16	2-3/8	Max	X	1000	125			-600	40	X	X	X		X	
828	Beam	80	30	75	GS	10	3.25	13.5	.05	14.5	7-11/16	2-1/6	Class C	X	1500	180	400	28	-100	12	205	2.2	4200	G3=+75V	200	
													Linear	X	2000	25/135	750	1/30	-120	0	120	0	9250	G3=+60V	190	
829B	Twn Beam	40	200	250	GRS	12.6/6.3	1.125/2.25	14.5	.12	7	4-5/16	2-3/8	Class C	X	750	160	200	30	-55	12	140	.8	4650		87	
832A	Twn Beam	20	200	250	GRS	12.6/6.3	.8/1.6	8	.07	3.8	3-5/16	2-5/8	Class C	X	750	65	200	22	-50	4	130	.24	5930		35	
833A	Triode	450	30	75	AGRS	10	10	12.3	6.3	8.5	8-13/16	4-19/32	Class C	X	2250	444			-125	85	300	23	2530		780	
													Linear	X	3000	50/375			-70	X	200	20	4750	X	825	
834	Triode	50	100	350	R	7.5	3.1	2.2	2.4	.6	6-11/16	2-11/16	Max	X	1250	100			-400	20	X	X	X		X	
837	Pent	12	20	60	GR	12.6	.7	16	.2	10	5-3/4	2-1/16	Class C	X	500	60	200	15	-75	4	100	.4	4165	G3=+40	22	
838	Triode	100	30	120	GR	10	3.25	6.5	8	5	7-7/8	2-5/16	Class C	X	1250	150			-90	30	200	6	4165		130	
849H	Triode	500	30		A	10	11.5	10	11.5	1.8	14-3/8	8	Linear	X	3000	50/450			-140	X	600	55	2000	X	960	
851	Triode	750	3	15	G	11	15.5	25.5	47	4.5	17-5/8	6-1/8	Linear	X	3000	55/600			-135	X	245	3	2800	X	1200	
955	Triode	1.6	600		R	6.3	.15	1	1.3	.4	1-3/8	21/32	Max	X	150	8			X	2	X	X	X		X	
958A	Triode	.6	350		R	1.25	.1	.45	2.5	.6	1-3/8	21/32	Max	X	135	7			-30	1	X	X	X		X	
1000T	Triode	1000	50		EG	7.5	17	9.3	5.1	.5	12-5/8	5-1/8	Class C	X	6000	167			-400	X	X	8	18000		800	
													Linear	X	5000	120/570			-105	X	265	16	4625	X	1850	
1613	Pent	10	45	90	GR	6.3	.7	6.5	.26	13.5	3-1/4	1-5/16	Class C	X	350	50	200	10	-35	3.5	70	.22	3500		9	
1614	Beam	25	80	120	RS	6.3	.9	10	.4	12	4-5/16	1-5/8	Class C	X	450	100	250	8	-45	2	73	.15	2250		31	
													Linear	X	530	30/80	340	10 pk	-36	0	36	0	3600	X	25	
1619	Beam	15	45	90	GR	2.5	2	9.6	.29	12.5	4-5/16	1-5/8	Class C	X	400	75	300	10.5	-55	5	80	.36	2670		19	
1624	Beam	25	60	125	GRS	2.5	2	11	.25	7.5	5-3/4	2-1/16	Class C	X	400	90	300	10	-60	5	95	.43	3340		35	
1625	Beam	30	60	125	GR	12.6	.45	11	.2	7	5-3/4	2-1/16	EXCEPT FOR HEATER, CAP & BASE, IDENTICAL TO 807													
1626	Triode	5	30	90	R	12.6	.25	3.2	4.4	3	4-1/8	1-9/16	Max	X	250	25			-150	8	X	X	X		X	
4037	Triode	6.25	3500		R	6.3	.145	1.8	1.1	.05	3-1/8	1-5/16	Class C	500	275	23			-51	7	X	2	6110			5
4604	Fil Bm	25	60	175	R	6.3	.65	11	.24	8.5	3-13/16	1-21/32	Class C	175	400	150	190	11	-60	2	X	4.5	1335		30	
5513	Triode	1500	220		G	6.3	30	14.4	(G-G) .09	10.5	6-7/8	3-	Linear (G-G)	X	2000	60/967			-20	180	240	223	X	X	1125	
5556	Triode	10	6	30	R	4.5	1.1	2.3	6.7	2.2	4-1/2	1-5/8	Max	X	350	40			-150	10	X	X	X		X	
5588	Triode	200	1200	2000	GR	6.3	2.5	13	6	.32	3-13/32	1-3/4	Class C	1000	835	300			-70	40	X	32	1390		100	

Guide

TUBE TYPE	CLASS OF TUBE	PWR DISS. WATT	FREQ OF MAX RATING	MAX USABLE FREQ	MFR	FIL/HTR VOLTS	FIL/HTR CURR.	CAP IN MMFD	CAP OUT MMFD	CAP G-P MMFD	MAX HGT IN.	MAX DIA IN.	TYPE OF OPERATION	OP FREQ MC	PLATE VOLTS	PLATE CURR MA	SCRN. VOLTS	SCRN CURR MA.	GRID BIAS VOLT	GRID CURR MA	RF DRIVE VOLTS	DRIVE POWER WATTS	LOAD IMP OHMS	3RD ORDER DISTORT	PLATE PWR OUT WATTS	PWR IN LOAD WATTS
7801	Beam	52.5	3000		R	12.6	.5	28.5	.025	2.2	1-5/16	3/4	Class C	1500	650	65	225	2	-24	4	X	3	5000		14.5	
													Linear Max	X	750	70	250	2W	X	15	X	X	X	X	X	
7842	Beam	180	2000		R	6.3	3.2	33	.065	4.52	1-15/16	1-1/8	Class C	1215	900	170	300	1	-22	4	X	5	2650			40
													Linear	X	850	40/173	300	0/12.5	-15	15	46	.3	1980	X	70	
7843	Beam	180	2000		R	26.5	.52	33	.065	4.52	1-15/16	1-1/8	EXCEPT FOR HTR, IDENTICAL TO 7842													
7854	Twn Beam	60	175	500	A	12.6/6.3	.9/1.8	6.7	int. neut.	2.1	4-1/32	1-3/4	Class C	175	1000	240	262	16.5	-85.5	5.7	X	3.5	2100			163
7870	Beam	52.5	3000		R	6.3	1	28.5	.025	2.2	1-5/16	3/4	EXCEPT FOR HTR, IDENTICAL TO 7801													
7905	Fil Beam	10	175		R	6.3	.65	8.5	.14	5.5	2-5/8	7/8	Class C	175	300	60	185	4	-39	2.2	43	1	2500			7
7983	Tw Fil Bm	14	200		A	3.15	1.65	5.4	int. neut.	1.7	3-1/16	7/8	Class C	200	200	90	200	10.2	-40	3	110	X	1100			9.8
8000	Triode	175	30	100	GR	10	4.5	5	6.4	3.3	8-3/4	2-9/16	Class C	X	2500	300			-240	40	480	18	4200		576	
													Linear	X	2250	33/225			-145	0av	150	7.9	X	X	363	
8003	Triode	100	30	50	R	10	3.25	5.8	11.7	3.4	8-3/16	2-9/16	Max	X	1350	250			-400	50	X	X	X		X	
8005	Triode	85	60	100	GR	10	3.25	6.4	5	1	6-9/16	2-7/16	Class C	X	1500	200			-130	32	255	7.5	3750		220	
													Linear	X	1500	83 av			-80	1 av	90	5	X	X	180	
8042	Fil Bm	25	60	175	A	1.6	3.2	13.5	.24	8.5	3-7/8	1-3/4	Class C	60	500	150	180	15	-71	2.8	91	.3	2000		65	
8072	Beam	100	500		R	12-15	1.3	38	.13	6.51	2-1/4	1-15/32	Class C	470	700	300	200	10	-30	20	X	5	1170			65
													Linear	30	700	100/205	250	16 pk	-20	1	40	.3	1420	-30		80
8077/7054	Pent	5	40		R	12-15	.275	10.2	.063	3.5	2-3/16	7/8	Class C	40	300	26	175	5.5	-12	1	16	.015	5800		4	
8121	Beam	150	500		R	13.5	1.3	38	.13	6.5	2-5/16	1-7/16	Class C	470	1500	300	200	5	-30	30	X	5	2500			235
													Linear	30	1500	100/210	250	10 pk	-20	.05	40	.3	3800	-35		170
8122	Beam	400	500		R	13.5	1.3	38	.13	6.5	2-1/4	1-5/8	Class C	470	2000	300	200	5	-30	30	X	5	3330			300
													Linear	30	2000	100/335	400	10 pk	-35	.05	70	.3	3050	-29		380
8149	Bm Pent	35	175		T	12.6/6.3	X	X	X	X	X	X	Class C	175	380	180	368	12	-78	X	120	2	1830		40	
8150	Bm Pent	35	175		T	12.6/6.3	X	X	X	X	X	X	EXCEPT FOR BASE, IDENTICAL TO 8149													
8167/4CX300A	Beam	300	500		ERy								Class C	250	2500	250	250					2.8			500	
													Linear	250	2500	1250	350			0		0			400	
8289	Beam	25	60	175	W	6-10	1.165	13	.24	8.5	3-13/16	1-23/32	EXCEPT FOR HTR, IDENTICAL TO 6146													
PL-8295/PL-172	Bm Pent	1000	60		P	6	8.2	38	.09	18	5-1/8	4-1/32	Linear	X	3000	220/800	600	11/39	-115	0	115	0	G3=+35 V	-32		1590
PL8295A	Bm Pent	1000	60		P	6	8.2	42	.09	21	5-1/8	4-1/32	EXCEPT FOR OPERATING TEMPERATURE, SAME AS PL-8295													
PL8432	Bm Pent	1000	60		P	6	8.2	42	.09	20	4-3/4	3-17/32	Linear	X	3000	200/800	600	3/52	-115	0	115	0	X	-27		1540
9002	Triode	1.6	500		R	6.3	.15	1.2	1.4	1.1	1-3/4	3/4	EXCEPT FOR CAPACITANCES, IDENTICAL TO 955													

Propagation

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
Alaska	14	7	7	7	7	7	7	7	7	7	14	14
Argentina	21	14	7	7	7	7	14	14	21	21	21	21
Australia	14	14	14	7	7	7	7	7	7	7	14	14
Canal Zone	21	14	14	7	7	7	14	14	14	21	21	21
England	7	7	7	7	7	14	14	14	14	14	14	14
Hawaii	14	14	14	7	7	7	7	7	14	14	14	14
India	7	7	7	7	7	14	14	14	14	14	14	7
Japan	14	14	7	7	7	7	7	7	7	7	14	14
Mexico	21	14	14	7	7	7	14	14	14	14	14	21
Philippines	14	14	7	7	7	7	7	7	7	7	14	14
Puerto Rico	14	7	7	7	7	7	14	14	14	14	14	21
South Africa	14	7	7	7	7	14	14	14	14	21	21	14
U.S.S.R.	7	7	7	7	7	7	14	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
Alaska	14	14	14	7	7	7	7	7	7	7	7	14
Argentina	21	14	14	7	7	7	14	14	14	21	21	21
Australia	21	21	14	14	7	7	7	7	7	7	14	21
Canal Zone	21	14	14	14	7	7	14	14	14	14	21	21
England	7	7	7	7	7	7	14	14	14	14	14	14
Hawaii	14	21	14	14	7	7	7	7	14	14	14	14
India	14	14	7	7	7	7	7	14	14	14	14	14
Japan	14	14	14	7	7	7	7	7	7	7	14	14
Mexico	14	14	14	7	7	7	7	14	14	14	14	14
Philippines	14	14	14	7	7	7	7	7	7	7	14	14
Puerto Rico	21	14	14	7	7	7	14	14	14	14	21	21
South Africa	14	7	7	7	7	7	14	14	14	14	14	14
U.S.S.R.	7	7	7	7	7	7	7	14	14	14	14	14

WESTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
Alaska	14	14	7	7	7	7	7	7	7	7	7	7
Argentina	21	14	14	14	7	7	7	14	14	21	21	21
Australia	21	21	21	14	14	7	7	7	7	7	14	14
Canal Zone	21	21	14	14	7	7	7	14	14	14	21	21
England	7	7	7	7	7	7	7	14	14	14	14	14
Hawaii	21	21	21	14	14	7	7	7	14	14	14	14
India	14	14	14	7	7	7	7	7	7	14	14	14
Japan	14	14	14	14	7	7	7	7	7	7	14	14
Mexico	14	14	14	7	7	7	7	14	14	14	14	14
Philippines	14	14	14	14	14	7	7	7	7	14	14	14
Puerto Rico	21	14	14	7	7	7	7	14	14	14	14	14
South Africa	14	7	7	7	7	7	7	14	14	14	14	14
U.S.S.R.	7	7	7	7	7	7	7	7	14	14	14	14

August Forecast

Good: 1-5, 13-19, 23-25

Fair: 6-9, 12, 20, 22, 27-28, 31

Bad: 10-11, 21, 28-30

Es: 1-2, 13-15, 18-19, 25-26

Es means the possibility of a high MUF and/or freak conditions.

Items of Interest

1. We are presently about one year from the minimum portion of the 11 year sunspot cycle. Monthly average sunspot numbers this year have been January 19, February 23, March 17, April 30. May is also showing an increase over March but this is temporary and the numbers should fall again. The last year comparable to the present was 1953 preceding the low of 1954. In 1954 the sun was nearly bare of spots for the first six months.

2. The useful frequencies of 1963 are almost identical to what they were in 1953 and signal qualities also show the same pattern. At this portion of the 11 year cycle, the Winters are bad and the Summers are quite good.

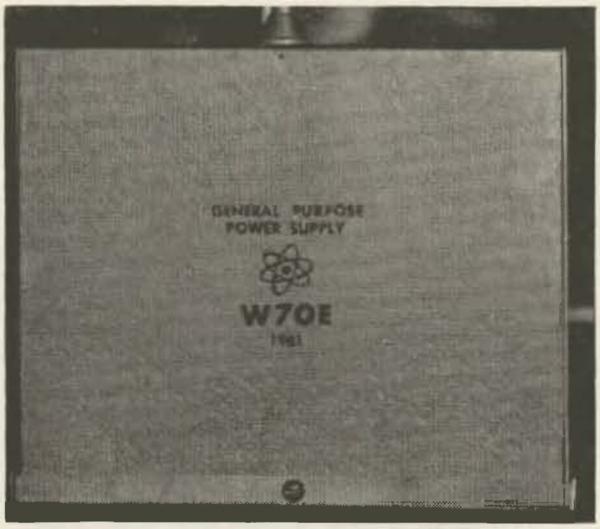
J. H. Nelson

A Tubeless, General Purpose Power Supply

Howard S. Pyle W7OE
3434-74th Ave., S.E.
Mercer Island, Wash.

How often have you wished for a source of ac/dc voltage on your work bench for tube filaments, relays, vacuum tube plate circuits and similar applications? Many times, no doubt. And if such a supply is adapted to powering ham transmitters, VFO's, receivers, modulator units and such as well as having various applications in hi-fi/stereo work, audio amplifiers for sound systems and a variety of electronic devices, you have a pretty flexible and convenient "power-house."

Conventionally, any versatile power supply unit which provides voltages as above, will pretty well fill the bill; maybe you already have one which is satisfactory. On the other hand the radio ham generally takes what he can from the "power plug" on the back of his transmitter or receiver which may or may not be adequate nor convenient for the use he has in mind. Why not *build* a supply which is portable and immediately available when you are building, testing or trouble shooting a piece of gear? Such a construction project is simple, is moderate in cost and of untold convenience around the ham shack. Let's build one; here's how.



Front view of the Power Supply Unit. Application of the small decals contribute to a professional appearance for home-made gear.

For the unit described and illustrated here, I chose the various components shown, based on what I wanted the little power-box to deliver and making use of what my "junk-box" would produce, insofar as possible. If *your* voltage requirements differ or you want to make use of other items of comparable ratings which you may have on hand, adjust your values and your physical dimensions to conform. For the purpose of this article we will stick strictly to the unit which I assembled and which has proven to be one of the handiest pieces of gear in my shop.

In the initial design, I shied away from a vacuum tube as the rectifier for several reasons. I wanted as compact a unit as I could achieve (and a tube rectifier takes considerable space). Next, I wanted something without a filament to burn out at an inconvenient time and with no spare tube on hand. Last, while not too important with proper venting, I gave consideration to the heat generated by a tube. With these factors in mind, I came up with the relatively recent idea of using silicon rectifiers rather than a vacuum tube. After figuring the voltage and current values I wanted (600 volts at 200 milliamperes), a couple of 500 ma rectifiers in series (for adequate voltage capacity) seemed to offer adequate voltage and current carrying ability with a generous safety factor. Connection of these rectifiers is plainly detailed in the schematic wiring of Fig. 2. Be *sure* that the polarities of your rectifiers are exactly as shown or you could ruin one or more . . . I lost two the first time around by "missing the boat" on polarities. The balance

of the wiring is conventional embodying the usual filter choke, filter condensers, bleeder resistor, fuses, terminal block, etc.

In duplicating the unit I built, the first step is to form a small sub-chassis to fit within the metal cabinet and provide a mounting for the transformer, choke, rectifiers, etc. I bent up this sub-chassis from a flat sheet of #16 gauge aluminum, 6" x 8", first cutting off all four corners at an angle of 45 degrees as shown in Fig. 1. Next, the transformer and choke were mounted, passing the wires from each down through grommet-bushed holes in the sub-chassis, then back up through similar grommetted holes at the proper points to reach their eventual terminations. This served to conceal a large portion of the wiring below the sub-chassis making for more professional appearance.

The mounting bases for the two pair of rectifiers can now be placed in position, using a short spacer between them and the sub-chassis. Mount the two filter condensers next . . . I used metal "wrap-around" clamps securing them through existing holes in the frame and core of the transformer. The bleeder resistor can then be mounted and with this the mechanical assembly of the sub-chassis is now complete and it can be set aside while you go to work on the cabinet.

The LMB chassis box which I used is an "L" shaped affair as shown in the photo. This shape makes it most convenient for mounting the terminal block, switches and panel lights on the end which is turned up from the base. By so doing, the cover and one end of the cabinet are readily removable with no wiring to trail between the two halves. Position your switches, fuses and indicator lights so that they will clear the transformer and mount the terminal block. Use small grommetted holes above the block through which to bring the wires to the terminal strip.

If you use terminal tie-points as I did, for the positive and negative leads of the filter condensers, mount them in appropriate positions now. You are then ready to assemble

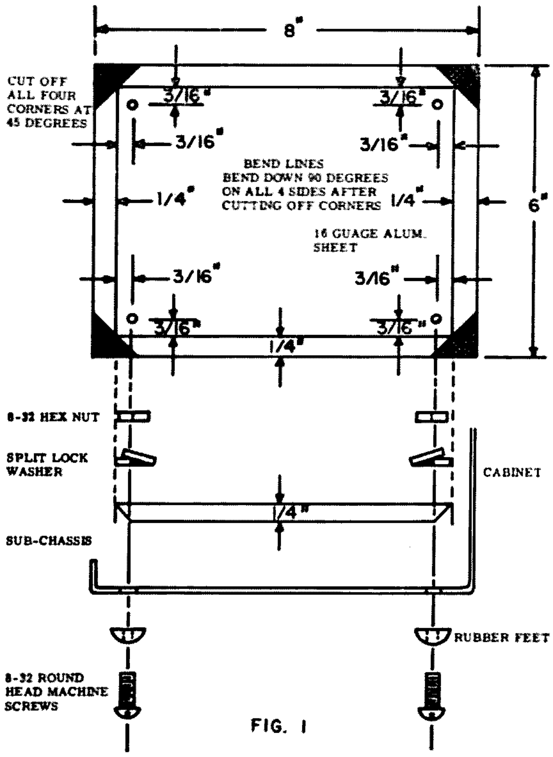
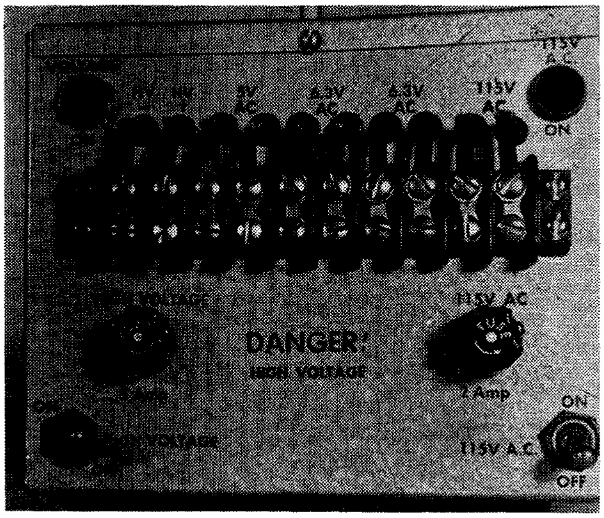
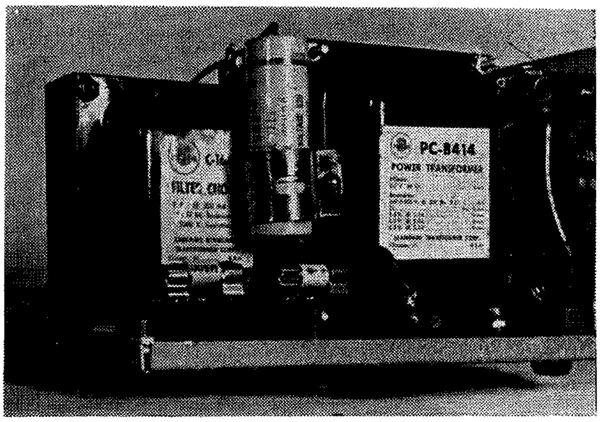


FIG. 1



The "business end" of the complete power supply unit using silicon rectifiers.



Internal view. The two silicon rectifiers conceal two identical rectifiers, one behind each of the two shown. The second filter condenser is located directly behind the one shown.

the sub-chassis to the cabinet base. Use 8-32 machine screws through the bottom of the cabinet and each of the four corners of the sub-chassis. Place the screw head on the bottom, first running it through one of the conventional small rubber cabinet feet and use a lock washer and nut on top of the sub-chassis to secure both the chassis and the feet. You can now pick up the loose ends of the wiring and connect them to their proper terminals.

After completing your wiring, test out your circuits, first with a volt-ohmmeter and finally by actually connecting the unit to a 115v ac source and measuring the various voltages at the terminal block. If you're satisfied that all is well, mount a handle of some sort on top of the "L" shaped cover; you'll find the unit much easier to move around if you do so. I used a handle I happened to have on hand from a piece of surplus military gear but you can pick up a satisfactory handle from your local hardware, building supply or variety store. Finish off the assembly by application of the neat little decal transfers available at all ham stores or electronic mail order houses, for professional appearance as well as ready identification of all external terminals, switches, fuses and indicator lights. Be generous with your decals; *know* what everything is and avoid the guess work when hooking various items to the unit.

If you prefer a *variable* dc output voltage, the internal bleeder resistor can be eliminated

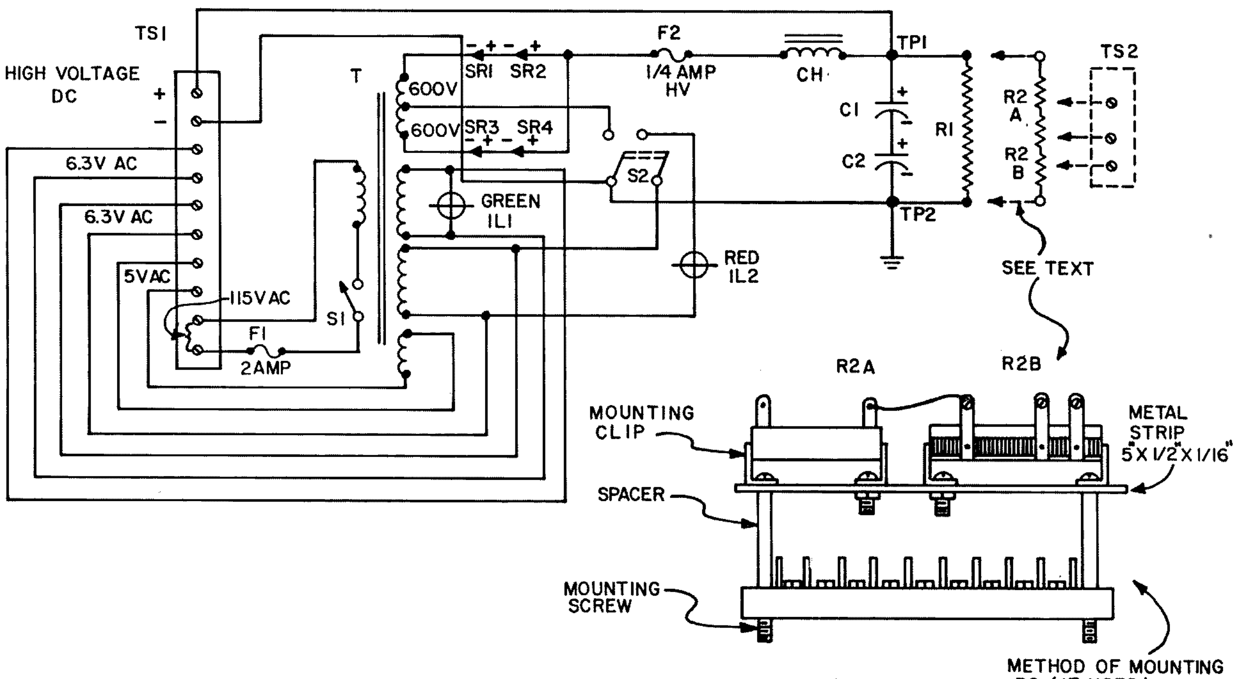


FIG. 2

and a voltage divider resistor of suitable physical size and electrical capacity can be mounted externally directly on top of the terminal block, supporting it slightly above the block by suitable spacers. Flexible leads from the voltage divider can then be led to a three or four point terminal block, appropriately marked, mounting it directly below the main terminal block, where the word DANGER now appears in the photo.

You'll find this little "power-house" a mighty handy and versatile piece of gear for your many experimental and testing operations around your shack or shop. Your cost can run anywhere from about five to twenty five dollars, dependent on your voltage and current requirements, how much equipment you'll have to buy and what your "junk-box" will produce. You have a wide leeway in choice of components and your physical dimensions can be adjusted to suit, but be *sure* and follow the circuit wiring shown in Fig. 2. . . . W7OE

Parts List

TS1—Cinch-Jones #10-141 Terminal strip
T—Chicago Transformer Company, PC-8414 Power transformer
F-1, F-2—Buss type HKP insert fuse holders
S-1—Cutler-Hammer #8280 SPST toggle switch-K16
IL-1, IL-2—General Cement #7908 panel light brackets
SR-1, 2, 3, 4—Sarkes-Tarzian silicon rectifiers type M-500
S-2—Cutler-Hammer #8300 DPST toggle switch-K7
CH—Chicago Transformer Company #C-1646 Filter choke
C-1, C-2—Sprague TVA-1611 40 mfd 350 volt electrolytic capacitors
R-1—IRC type 2D, 25 watt, 50M ohm, wire-wound fixed resistor
R-2 (A & B)—IRC type 2DA, 25 watt adjustable resistor and IRC type 2-D 20 watt 25M ohm fixed resistor in series
TP-1, TP-2—Cinch-Jones type 51 single terminal tie-points
Cabinet—LMB Chassis Box type 865-EL

Confessions of an Electronic Genius

and how to become one yourself

Fred Blechman K6UGT
23958 Archwood St.
Canoga Park, California

Have you ever been asked to fix a single-sideband transmitter, even though you weren't really sure how a simple oscillator works? Well, I have. In fact, I'm always being asked questions I shouldn't be asked. Why? Because in the minds of some around me, despite my claims to the contrary, I am an electronic genius!

How did I achieve this status? How can *you* attain for yourself the dubious distinction of being an "electronic genius?" Well, if you promise not to blab it around, here's the story . . .

The Genius Is Born

I suppose it all started when I decided to build my own radio-control equipment for a model airplane. The fact that I knew nothing about electronics didn't stop me; I was surrounded at work by electronic geniuses who could solve virtually any problem involving the lowly electron. Or so I thought. Anyhow, the kit I bought was a real collection of mysterious goodies; wire, coils, tubes, phenolic, and those cute little cylindrical things with the pretty colored bands. I meticulously followed the instructions and sketches in the assembly of the receiver, a simple "single-tube super-regenerative receiver," according to the description. Since I had no equipment to check out its operation, I took it to work for the electronic geniuses to fire-up. They performed their usual mystical rites with strange looking devices. The receiver refused to be impressed by the display . . . and just did not work!

The next two weeks were almost too painful to describe. Complete lunch hours were consumed in discussion, theory and testing by the geniuses. My greatest contribution was keeping my fingers crossed. The geniuses, individually and collectively, all had their chance at trying to seduce "Fred's Folly" into operation. Words like superheterodyne, intermediate frequency, converter and mixer were generously sprinkled throughout their discussions. "But," I kept repeating, "this is a super*regenerative* receiver!"

The geniuses thought I had flipped. "Regenerative receivers went out with the Model T" they said, patting me on the head sympathetically.

Well, they finally gave up, and I was about to take up basket weaving as a new endeavor, when a hot spell proved fortunate; I noticed one of the silver-colored cartridge-shaped things in the receiver was leaking at one end, apparently from the heat. Could this be a bad part? It was marked ".01 MFD 100V." When this unit was replaced, the receiver worked. I had fixed it! The geniuses just shook their heads. "You are truly an electronic genius" they confided . . .

The Genius Grows

The bug had bitten. More receivers, more transmitters . . . and many more problems. Somehow, never really knowing how or why, I always managed to stumble on a solution. Pretty soon I found myself fixing other guys' equipment; you've heard the expression "the blind leading the blind" . . .

About this time I decided to really find out what electronics was all about. Somehow I was not able to find anyone who was willing to sit down with me for twenty minutes and tell me all there is to know about electronics. So I attended night classes at the local high school, where I got to twirl knobs in the lab. I bought test equipment with knobs of my own to twirl. I repaired every radio the neighbors found in their attics. And, most important of all, I subscribed to "73."

My reputation grew. Radio repairing is, after all, mostly tube changing, dial-cord restringing, replacement of obviously cooked parts, and a generous seasoning of good luck. (Knowing what you're doing can replace the good luck; in my case the good luck was the essential ingredient.) "You," they would tell me, "are an electronic genius!" By this time I was able to identify at least three different kinds of parts.

The Genius and the Theory

I found myself more and more becoming a victim of the never expressed, but universally accepted, theory of the masses: "He who knows *anything* about electronics knows *everything* about electronics." There is, however, a lesser known corollary to this theory: "He who knows *anything* about any particular branch of electronics knows practically *nothing* about any other branch of electronics." I couldn't convince anyone that the latter theory more expressed my capabilities. "If it plugs into the wall, or uses a battery, Fred knows all about it," they insisted.

The Genius Takes to the Air

Then I got my ham ticket. That really did it! When my roof began sprouting weird antennas, and the neighbors' TV sets began acting in a strange manner, they were more convinced than ever that another Steinmetz was their private electronic consulting engineer. I was asked about everything from ailing TV sets (I carry service insurance on my own set) to improperly operating electric blankets (when mine quit recently, I bought a new one). And it doesn't end there; I've even found myself answering questions on the air about how to plate-modulate a transmitter, or how to eliminate chirp on CW. Sometimes I have some idea what I'm talking about, but certainly not always. However, if I tell them I don't know what I'm talking about then I am considered overly modest; if I offer no suggestions, the conclusion is that I don't care enough to even think about the problem. A dilemma. I have found it easier to give them an answer they don't understand than to try to convince them that I'm talking through my chapeau.

The Genius Goes Stereo

Take the other night, for instance. Andy, who has known me long enough to know better, brought over a stereo tape recorder he had just built from a kit . . . his first tussle with electronics. He said that the left channel was dead. Not being a tape recorder specialist, or any other kind of specialist, I did the only thing I could think of at the moment; I plugged in the "kluge" and turned it on. Music poured forth from both channels, loud and clear. "What did you do to it?" Andy asked.

"Nothing," I replied.

"There you go being modest again," he said. "All you electronic geniuses are alike."

Then we tried to record. No erase. So I unbuttoned the whole works and looked at the maze of wire and stuff and things inside the chassis. I noticed two shielded cables from the erase head terminating in two plugs on the chassis. On a wild hunch (my usual method) I swapped the two plugs in their sockets. This cured the trouble. To Andy this was sheer wizardry. When I tried to explain the four-track stereo tape system, and the operation of the record and erase oscillator, he absorbed about as much as a third grader trying to learn the Pythagorian Theorem.

That's about the time the left-channel playback went dead. I had no recourse but to resort to the scientific approach. Using the dirty wooden handle of a small, dirty paintbrush that happened to be laying on my dirty workbench, I pushed and shoved everything in sight under the chassis. Responding to this precision trouble-shooting technique, the left-channel burst forth in full bloom. More probing disclosed that a single strand of shielding had lodged itself against the grid of the left-channel pre-amp tube!

Now the left-channel magic-eye record level indicator tube was acting oddly. Andy was obviously *right*-handed! No amount of pushing and shoving with the paintbrush handle did any good. This exhausted my supply of magic tricks, so I suggested that we put the whole works back in the case and be glad that it hadn't gone up in smoke. All buttoned up, we gave it the final check. No one was more surprised than I when everything worked, including the left-channel magic-eye indicator! "You did something when I wasn't looking," accused Andy.

With a knowing expression, I replied, "The hand is quicker than the 'eye,' my friend . . ."

. . . K6UGT

Squelch for the Twoer and Sixer

Richard Koenig WØTWP
3 Ladue Ridge Road
St. Louis 24, Mo.

The amazing litle "Benton Harbor Lunch Bucket" is a very popular transceiver and is found in practically every ham shack for communications of one type or another.

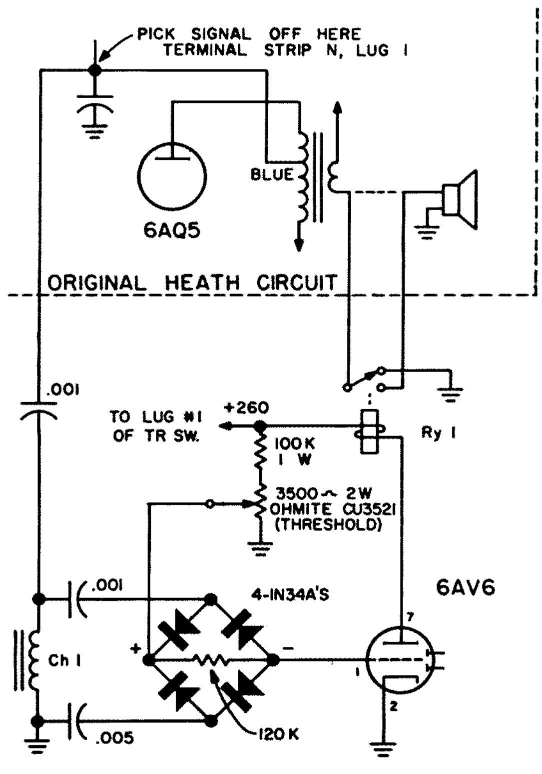
Although their performance is excellent, the characteristic hiss noise from the super regenerative receiver can be somewhat annoying while monitoring for any length of time. A good squelch, all will agree, would make the little beasts much more enjoyable during standby, while awaiting a signal.

This sensitive and 100% effective squelch has been used by the author and several friends with great satisfaction, both mobile and fixed. If you have a TWOER or a SIXER, we would like to share our enthusiasm with you.

Here is how it works. The annoying hiss noise, which has its main components above 8000 cycles per second, is considerably higher in audio frequency than the audio modulation frequencies of an incoming signal. This hiss, which drops in level when an incoming signal appears, is used to actuate the speaker killing circuit.

The receiver audio signal, taken from the audio output trasnformer primary tap, is passed thru a high pass filter, rectified and applied as a negative control grid voltage to a 6AV6 dc amplifier. With no signal present the high negative grid voltage, created by the high hiss level, reduces the plate current of the 6AV6, which opens the plate relay, killing the speaker. When a signal appears, the hiss level of the receiver decreases and lowers the negative grid voltage to the 6AV6. This causes it to draw higher plate current and closes the plate relay, actuating the speaker.

The squelch threshold control, R1, is adjusted to bias the grid circuit of the 6AV6 to hold the relay just open, with no signal present. For any chosen volume control setting, there is a point on R1 which will set the squelch at the edge of the threshold.



APPROXIMATELY 3 Ma. ACTIVATES Ry I

RY.—spdt relay 10,000 ohm P.B. type RS5D
CH.—.250 hy rf choke Suprex Varichoke V-70

Although very suitable for outboard arrangement, since only power and three leads are involved from the transceiver, the squelch has proved so satisfactory that it has been installed on the chassis of each set used in the pioneering and tests. The threshold control mounts on upper front panel, the relay on a piece of plastic mounted on speaker bracket and the 6AV6 on the chassis between the filter can and the 6AQ5. Well worth the effort.

The use of a Vector lug type socket for the 6AV6 enables all small components to be mounted and wired directly on the socket prior to mounting. A reminder may be in order to leave some length on the diode leads to protect them from heat while soldering. The 250 mh choke should have its ajustable core fully engaged. This allows the filter network to pass 8000 cps and higher. The dc output of the diode bridge rectifier, as measured at the + − signs on the schematic, should read approximately 12 volts with the volume high and no signal tuned in. (20,000 ohms per volt meter used)

For the best stability, the regeneration control of the transciever, R11, should be advanced to near maximum. L5 and L6 can be adjusted, with the meter connected, to make the no signal control voltage constant across the entire dial.

Due to its unique principle of operation, this squelch is not triggered by normal noise or automoble ignition, which proves to be a pleasant feature while mobiling or operating in a noisy area.

. . . WØTWP

$25 Cheap

Leonard Tamulonis W1MEL
73 Staff

It was a bargain at any price! Thirty feet tall, three-legged, solid steel, and all mine for twenty-five dollars cheap. It was the best darned windmill turned radio tower I had seen in a long time. How did I get this gem? Well, it seems that one of the local boys had gotten orders to paint his tower, or his XIL swore she would plant a petunia and clinging vine jungle all over it. Since he didn't have money for paint (he'd sunk his allowance into a pair of 813's) and couldn't stand the humiliation of trying to prune Morning Glories to fourteen megacycles, he decided to get rid of it . . . and li'l old me was standing right beside him when he did.

A bargaining period over a bottle of brew brought the price to the aforementioned twenty-five dollars, along with a fifteen meter beam thrown in with the tower for chuckles. Now came the problem of moving the thing.

Getting this cargo clear across town to the QTH was not going to be an easy matter, but a quick call to a friend in the concrete block business brought the loan of a twenty-foot open truck. Block and tackles, ropes, chains, cases of beer, and whatnot were all assembled, and we waited for the following Saturday morning when we'd rise bright and early to face the task of moving said tower to Fulton Street.

There were six of us that fateful morning . . . the other three had shown up to kibitz, watch, and generally make trouble. It was immediately decided to hook a block and tackle to the top of the tower, and string it to the top of a nearby tree. In this way all we had to do was tip the tower and slowly let out the line until the tower was gently set on the ground. But of course it never happened that way. After getting all set, the tower was tipped, and the block and tackle slowly let out. By some miscalculation Joe Gooberduck was stationed at the pulley rope. Now Joe is not the type to be put in such a position, because he's only five feet three, 113 pounds and underfed. So down came the tower, and up went Joe.

After the dust had cleared, Joe was nowhere in sight. He was stuck high up in the nether regions of the tree, with the pulley rope

wrapped around his head. Someone eventually got up enough courage to get a ladder and let Joe down. We all stood back when he reached the ground, but since he was so small, all he did was go behind the garage and kick the fence a few times.

When the fun was over, everyone silently stood around and surveyed the situation. Fortunately the tower was not damaged to the extent that a little whanging with a sledge hammer wouldn't fix, so once more we all hitched up our belts and prepared to move the monster* onto the truck. After backing the truck into the yard,** two leverage poles were forced under the tower legs, and everybody strained . . . nothing happened. We all tried again, and this time we accomplished something . . . two backs were sprained. We gave up until the next morning.

We started again early the next day, and this time we succeeded in only crushing two fingers, and spraining one wrist.*** It was worth it though, we finally got the thing on the truck. All this was accomplished, mind you, in the fantastically short time of six and a half hours. We backed out of the yard,**** and started up the street. We didn't get to the corner, when a jar shook the truck. Low hanging telephone wires had done us wrong. The monster was sticking up over the roof of the cab, and had caught on some nice, expensive looking cables. A call to the telephone company, an explanation, and a flattening of the wallet soon set things straight.

We couldn't pull the tower much lower on the truck, so a man was put on the tower top to call warning of any coming obstructions. We started up again, and had not gotten as far as the next corner when I heard a scream. Our man on the tower got caught on a phone pole, and was hanging onto a cross member for dear life. He got down by himself, but he spent the rest of the day pulling splinters out of his legs, and nursing his newly flattened feet. This put a stop to riding on the tower . . . it didn't look very cute anyway.

We got the rest of the way across town without too much trouble, although we sure got stares from startled pedestrians. After all, it isn't every day you see a windmill covered with radio hams grinding down a busy street. We got stopped by a gendarme who wanted to know what a windmill was doing on a truck with all kindsa funny people crawling over

* We had come to the point of giving it an affectionate handle.
** Being careful to drive in the flower beds.
*** All mine
**** Again making sure to drive in the flower beds.

it. We started to explain, but when we told him we were radio hams, he just mumbled and went back to his beat. The ham faction is well known in this town.

Approximately five hours after blast-off we arrived at Fulton Street, where we thought we'd be safe. But, our haven was short-lived, because the neighborhood kids had their scouts out, and they all were waiting for us when we turned the corner. This isn't the safest way to travel . . . I mean with tykes gamboling in front of a ten-ton truck you are driving. Asking them to desist brought nil results, so all the neighborhood parents were put on alert, and *that* got results! In fact one of our windows still gets broken now and then by one tyke who still remembers, even though he's in his twenties now.

After some jockeying to line it up with the driveway, the truck was backed into the yard. Five minutes later someone remembered to open the gate. This was a silly thing to think of now, because the gate had been sort of opened by the truck. Anyhow, we backed the whole shebang into the yard, and unceremoniously slid the tower, beam and all into the nearest rosebush. After everything was unloaded, the truck was driven out of the yard and over the gate, leaving some nice big ruts in the lawn for the kids to play in.

We quickly fell to work in getting the block and tackle hopelessly tangled in the tower struts, and seeing how long it would take to get the beam bent beyond recognition (it didn't take too long). One of the kibitzers suggested reversing procedure in putting the tower up as opposed to the way we took it down. Who ever heard of something falling up? The tower was maneuvered so the base pointed to the foot of an old Oak, and a block and tackle was fastened to the mast-hole. One of the more nimble-footed members of our lot volunteered to climb the tree and tie the other end to a sturdy looking branch near the top. Of course something had to go wrong. No matter how sound our ideas may be, something always happened. This time, we found that the sturdy looking branch was stuck to the tree with a little bit of rotten bark. You can guess what happened . . . we spent the next few minutes picking pieces of rotten wood out of our noggins.

The rope was re-tied further up around the trunk and the tower was hoisted up and settled into position without any more trouble. Our tree climber untied the rope and shinnied down to join us. We all stood in a group and watched the beam swing merrily in the wind. I forgot about the co-ax.

Nobody noticed this little oversight, and I wasn't about to mention it, or I would have been hung from the elements. I prudently suggested we all go and open some cases of brew to cap off this little tower raising bee. The motion was seconded and passed, and we all adjourned to consume some light special.

The tower had been up for two hours when the telephone rang. "You're messing up Lawrence Welk. Get you're radio station off the air or I'll call the police!" My protests were given to a dead phone . . . the caller had hung up. Three more calls followed almost immediately, and they were all about TVI. I wasn't even on the air! I didn't have any co-ax on the beam! The mere presence of the tower revealed the fact that I was a radio ham. The calls continued all night long, and every night for the next week. I got so disgusted with the whole thing, I never put co-ax on the beam. I've been trying to get rid of my little advertiser ever since.

So there she sits today. Rusting away in the rear of the house with a free-wheeling 15 meter beam spinning away with the wind. There's a dandy squirrel's nest on the rotor platform, and a sagging 40 meter doublet hanging from the mast-hole. I still get an occasional phone call about TVI, but it's usually from some new neighbor who saw the tower, and mistook ignition interference for me on channel five. Anybody want to buy a tower . . . cheap? . . . W1MEL

Letters

Dear Wayne,

What are you going to do about the slanderous statements made by W4HMK/1 in June QST? I realize that he will be excommunicated, but shouldn't we retaliate?

Harvey Rock WA2BWQ

The QST financed Hiner "survey" is a great promotion idea. I'm now making plans for 73 to finance a similar survey and have been guaranteed that our *impartial survey will show that 73 is almost entirely responsible for all sales of ham equipment.*

Dear Wayne,

Regarding the ARC-3 transmitter conversion, June 1963: This article may cause some readers to assume that the automatic tuning equipment is useful primarily for commercial remote control service. Actually, it is very handy for ham operation, particularly when you consider that it comes installed, ready for use. Unlike the 522 or ART13, there are no preset channels, and as a result, no problems regarding VFO operation. Before removing the autotune, try it out.

James S. Hill W6IVW

Incentive Licensing and the Institute of Amateur Radio

Membership applications for the Institute of Amateur Radio have taken a sudden leap upward following the ARRL's decision to try to get the FCC to return to the old principle of restricted voice bands for the few. It has been slowly dawning upon tens of thousands of General Class licensees that this means that they will be virtually thrown off phone unless they decide to stand up and fight for their interests. The only other organization we have in ham radio is the Institute and they are turning to it in increasing numbers.

Now though the Institute was formed for peaceful purposes, the extent of the approaching disaster seems to call for drastic measures. Before the Institute can take a stand it must know the desires of the members so it can express these desires to the best advantage and coordinate the group effort for maximum effect.

Membership in the Institute is one dollar per year. There are at present somewhat over 2000 paid members. Members will receive an attractive membership card and may use the Institute insignia on their QSL cards.

Membership Application: Institute of Amateur Radio

Name .... Call ....

Address ....

City .... Zone .. State ......

Class License .... Licensed since ......

– I am opposed to restricted voice bands.

– I am not opposed to restricted voice bands.

(All present members of the IoAR are requested to send in this form so we can count your vote too.) Mark here if you are a member.....

International Crystal's Add On Circuit

When the ads for the International Crystal Add On Circuits came out a few weeks ago our eyes lit up. Something new! We sent immediately for the spec sheet to see what was involved. We were skeptical of the idea, we have to admit, fearing that a unit built up out of individual circuits would be far more costly and poorer performing than regular commercial units.

We should have known better. International Crystal has been putting out circuits for quite a few years now and they have all been just about unbelievable in their performance and low cost. They must be using wetbacks or something on their assembly lines to keep costs down so far.

When the poop-sheet arrived we all poured over it and decided that we'd try a cascode grounded grid two meter converter. This seemed like the best test we could make since we had a Tapetone 417A converter and a new Amplidyne nuvistor converter on hand for comparison. We made out the list of circuits we needed and sent it down.

Within an amazingly few days a carton of small boxes arrived. About three hours later these had resolved themselves into a good looking two meter converter. The assembly was quite simple and the wiring could easily have been done by a female Novice.

It doesn't really make any difference how reasonable a converter is in price or how beautiful in looks if it doesn't do a good job of converting. We took the converter to our new VHF shack and set up a comparison test using a Waters coaxial transfer switch so we could get S-meter readings on the AOC converter and the Tapetone converter or the Amplidyne converter. In theory the 417A Tapetone converter should have been a little better than either of the others, but in direct comparison we found that the International Crystal Add On Circuit converter and the Amplidyne were about equal and both better than the Tapetone. This tells us two things: the AOC converter is indeed a hot one and our Tapetone converter needs some work.

After looking over the data sheets on the AOC's we discovered that merely by changing the crystal and retuning the slug-tuned coils we would have a 220 mc. converter. Since we're planning on using 220 soon the converter is back on the workbench being retuned and a new crystal is on order.

The basic idea of the Add On Circuits is that you can buy just the circuits you need to build the equipment you desire. Later, if you want to change it to something else or add an extra stage of amplification, it is very simple to do.

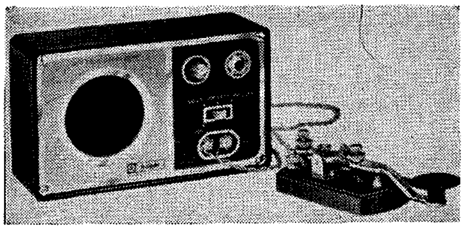
For instance, on the two meter converter we start out with a slug-tuned coil for the input, a 6DS4 nuvistor grounded grid stage, a double slug-tuned coil unit, a 6BH6 mixer unit, a crystal local oscillator unit, a coil unit, a 6DS4 multiplier unit, another coil unit and a power connection unit. Goes together like building blocks.

Just one use of these new circuits convinces us that International Crystal has a great idea there. We might expect a lot of imitators if they hadn't shrewdly kept their prices so low as to discourage competition. The bill on the complete two meter nuvistor grounded grid nuvistor cascode converter, including all tubes, hardware, chassis, etc., was only $68.35!

Drop a card to International Crystal, 18 North Lee, Oklahoma City 1, Oklahoma and ask for their spec sheets on the AOC's.

. . . Wayne

Knight-Kit Code Oscillator



Knights-Kits for all sorts of ham gear have been springing up in profusion. Allied Radio has been consistent in their program to produce low cost equipment in kit form which performs well. The new LC-1 code practice oscillator kit priced at only $7.95 is a good illustration. This kit includes a complete osclla-tor, cabinet, loudspeaker, hand key, plus a jack for earphones and a flashing light. The kit assembles easily, giving confidence to any neophte that he need not be frightened by the mysteries of electronics.

The oscillator is LOUD. This unit can be used for any size group that you will probably be able to gather for practice. Around the 73 Hq we not only use the LC-1 to pry our one lazy Technician into the General ranks, but it also serves to warn of impending meals and to wake everyone up in the morning. We get a lot of mileage out of things here.

You can patch the LC-1 into your rig for MCW transmission up on two meters if you go for that sort of thing. There is a label with the morse code on it for the case which is handy for phone men. Heh, heh.

$7.95, Knight-Kit (Allied Radio). Works. Two transistors, built-in battery (included in kit), profusely illustrated instruction book, etc.

More on the use of The SWR Meter

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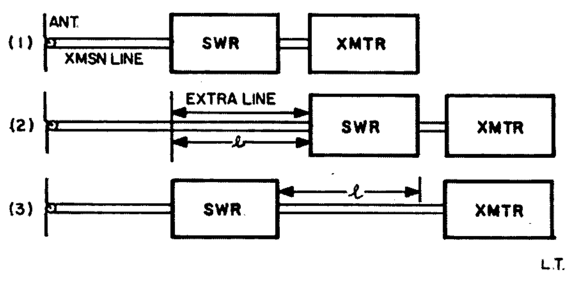
On a low loss transmission line which is perfectly matched at the antenna termination the rf voltage along the line is just that of the incident wave and is nearly constant along the full length of the line. However, if the antenna termination is not perfectly matched, a wave will be reflected back from the antenna end of the line and this reflected wave will have a voltage whose magnitude is something less than that of the incident wave. We now have two waves traveling on the line. In the case of an unmatch at the transmitter end we will have multiple reflections and will have many individual waves. However, all of the waves traveling in one direction can be added together to form a single wave traveling in that direction. Thus, we need only consider two waves, one traveling from the transmitter to the antenna end of the line and one traveling in the opposite direction. Both of these waves, when considered individually, have a magnitude which is relatively independent of the position on the line at which they are measured. However, when we add the two waves together to get the total rf voltage, we find that because the phase relationship which exists between the two waves is a function of the position on the line, that the *total* voltage is also a function of the position on the line (this is the voltage one would measure with a simple rf voltmeter inserted across the line). If the magnitude of the reflected wave is equal to that of the incident wave, there will be points one-half wavelength apart on the line where the *total* voltage is zero, even though the voltages of both the incident and the reflected waves at this point are *not* zero, and are, in fact, the same as they are at every other position on the line.



Mr. Wilds, in his article on p. 42 of the October 1962 issue of 73 makes the statement that since most of the inexpensive SWR bridges are voltage operated devices, that locating the SWR bridge at a voltage null point on the line will cause the SWR to appear to be deceptively low. This is not correct for a correctly adjusted bridge because the SWR reading which is obtained is proportional to the *ratio* between the voltage of the outgoing wave and the reflected wave and *not* to the *total* voltage existing on the line at the point where the SWR meter is inserted. If the SWR meter is operating correctly and if the length of the feed line between the transmitter and the receiver is not changed, the reading obtained on the SWR meter should not vary with its position in the feed line, assuming that the SWR meter itself does not introduce any discontinuities.

Mr. Wilds suggests the using of an extra piece of coax to determine whether the indicated SWR is different from the actual SWR. This is somewhat misleading, since if there is a mismatch between the transmitter and line as well as between the line and the antenna, changing the length of the transmission line between the antenna and the transmitter may very well change the *actual* SWR on the line. However, the extra–coax method is quite valuable as a test of not only the matching of the antenna to the line, but also of a test of whether the SWR meter is operating correctly,

and of the match between the transmitter and the line.

The following procedure can be used to determine whether the fault lies in the SWR bridge or in the match between the transmitter and the line. For the most dependable results, it would be a good idea to try the experiment twice with two different lengths of coax, 1, neither of which is a multiple of λ at the operating frequency.

First connect the circuit as shown in (1) and measure the SWR, then connect it as shown in (2) and (3) and get SWR measurements in both cases. If all three SWR measurements are unity, the line is well matched at the antenna termination, but no information is obtained on either the SWR meter or the transmitter–line match. If this is the case, and if it is desired to check the latter two items, a deliberate mismatch may be introduced at the antenna end and the measurements repeated again. Assuming now that SWR measurements other than unity are obtained, we can list the following conditions and their causes:

A. If the SWR obtained in all three cases is the same, the SWR meter is operating properly and the transmitter is matched to the line, but the antenna is unmatched.

B. If the readings obtained in (1) and (3) are the same and different from that obtained in (2), then the transmitter is properly matched to the line, but the antenna is unmatched and the SWR meter is not operating properly.

C. If the readings obtained in (2) and (3) are the same, but different from that obtained in (1), then the SWR meter is operating properly, but neither the antenna nor the transmitter is matched to the line.

D. If none of the readings agree within a few percent, then the SWR meter is not operating properly, the antenna is not matched to the line, and the transmitter is not matched to the line.

If the above tests indicate that the SWR meter is not operating correctly, then it should be adjusted according to the manufacturer's instructions, using a good dummy load and operating at the same frequency at which it is desired to make the transmission line measurements. After the SWR meter is adjusted correctly, if trouble is still encountered getting either an (A) or a (C) condition, the trouble may be in the introduction of discontinuities at the coax connectors which are used in inserting the short length, l, of coax into the transmission line, or the SWR meter itself may be disturbing the line. Once these problems are elimi-

nated, the above procedure may be used to match *both* the antenna *and* the transmitter to the transmission line.

Mr. Wilds also makes the statement that by using the proper length of line it is easier to load up the transmitter. This is true insofar as getting the maximum power out of the transmitter is concerned, but the very fact that the line still is not flat means that an excess amount of power is being lost on the line due to the waves which are being reflected back and forth, and/or that power reflected back along the line is being dissipated in the transmitter tank circuit. The only way to get rid of these losses or to reduce them to a tolerable level is to have a reasonably good match on both ends of the transmission line. This is the only method of getting the most transmitter power into the antenna, and it has the added advantage of reducing TVI (either directly or by permitting the use of a low-pass filter in the line). . . . W8JWP

Vertical Antennas

Herbert Brier W9EGQ
385 Johnson Street
Gary 3, Indiana

Apparently an increasing number of new hams getting on the lower-frequency ham bands are putting up vertical antennas, but most old timers still prefer the horizontal antenna. Does this mean that the newcomers are being oversold on the vertical through lack of theoretical and practical knowledge, or are the old timers overlooking a good thing by passing up the vertical antenna? Let's try to find out.

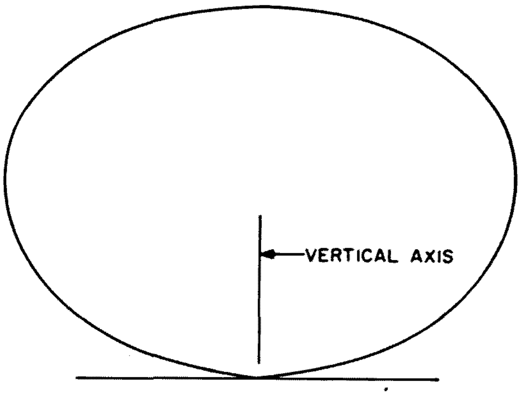
What Makes a Good Antenna

Obviously, how well an antenna performs is determined by the percentage of the power fed into it when it radiates in the desired direction. *Direction* in this connection means both the compass direction and the angle above the horizon at which the radiation takes place. The latter is important, because practically all radio communications over distances much in excess of 50 miles on the frequencies between 1.5 and 30 mc are accomplished by signals radiated by transmitting antennas at angles above the horizon striking the ionosphere between 65 and 250 miles above the earth and being refracted back to the earth miles away.

For example, between the U.S.A. and Europe, signals arrive at angles between 10 and 35 degrees on 7 mc 99% of the time. On 14 mc, the arrival angle is between 6 and 17 degrees 99% of the time. Nine degrees is the median angle for DX signals on 10 meters. Higher angles of radiation are, of course, useful over shorter distances, particularly on the lower-frequency amateur bands.

With these facts in mind, let's look at the vertical radiation patterns of the simple horizontal and vertical antennas shown in Fig. 1A to ID and 2A to 2D. From these patterns, it is easy to see that a horizontal antenna requires a height of 65 to 70 feet (½ wave on 7 mc, 1 wave on 14 mc) to achieve the low angles of radiation most desirable for DX work. But a vertical antenna ¼ to ⅝ wavelengths long is a powerful low-angle radiator. (Even a ⅛ wave vertical is a low-angle radiator, but the losses introduced by the necessary loading coil and other factors touched on later decrease the efficiency of such short antennas.

Incidentally, Fig. 2A to 2D apply to vertical antennas operated against an artifical "ground plane." In its simplest form, a ground plane consists of three or more (usually four) ¼-wave wires arranged like spokes of a wheel under the base of the antenna. Strictly speaking, the artificial ground must be at least ¼ wavelength above the earth to function as a true ground plane. At lower heights, the effective ground establishes itself somewhere be-

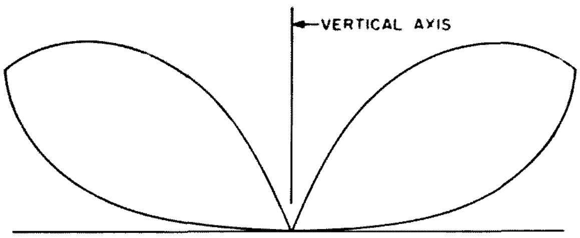


HORIZONTAL ANTENNA 1/4 WAVELENGTH HIGH

VERTICAL PATTERN OF HORIZONTAL ANTENNA 1/8 WAVELENGTH HIGH IS SIMILAR, EXCEPT LESS POWER IS RADIATED BELOW 45°.

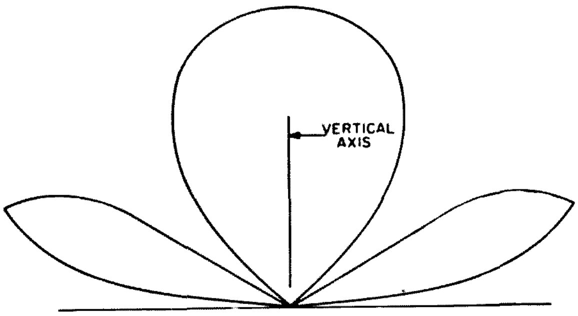
FIGURE 1A

Figures 1A, 1B, 1C and 1D. Radiation patterns in vertical plane of horizontal antennas 1/4, 1/2, 3/4 and 1 wavelengtn high respectively. Perfect ground assumed.



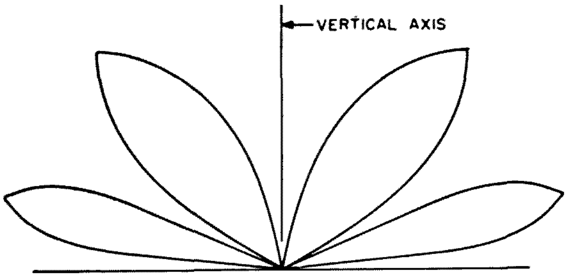
HORIZONTAL ANTENNA 1/2 WAVELENGTH HIGH

FIGURE 1B



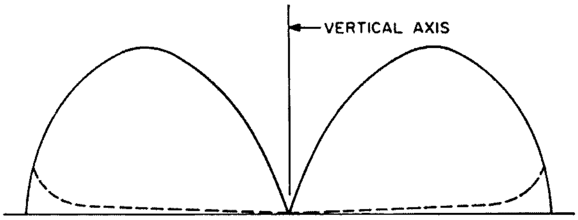
HORIZONTAL ANTENNA 3/4 WAVELENGTH HIGH

FIGURE 1C



HORIZONTAL ANTENNA 1 WAVELENGTH HIGH

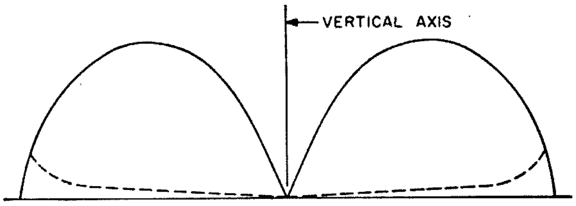
FIGURE 1D



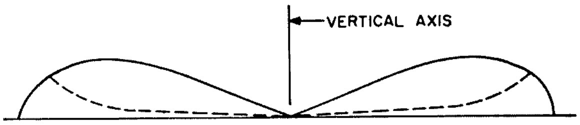
VERTICAL ANTENNA 1/8 WAVELENGTH LONG.

FIGURE 2A

Figures 2A, 2B, 2C and 2D. Radiation patterns in vertical plane and all compass directions of vertical antennas 1/8, 1/4, 1/2 and 5/8 wavelengths long, respectively. Antennas mounted a few inches above earth or ground plane. Power at angles below dotted lines absorbed by ground losses.

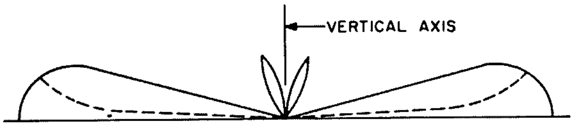


VERTICAL ANTENNA 1/4 WAVELENGTH LONG.
FIGURE 2B



VERTICAL ANTENNA 1/2 WAVELENGTH LONG

FIGURE 2C



VERTICAL ANTENNA 5/8 WAVELENGTH LONG

FIGURE 2D

tween the earth and the artificial ground; nevertheless, these lower quasi-ground planes usually work quite well.

From the above information, it is easy to see why the vertical antenna has the reputation of being a good DX antenna. But how does it live up to its promise?

The ARRL *Radio Amateur's Handbook* says, "If it were not for its ground losses, the omnidirectional radiation pattern and its low angles of radiation would make a vertical antenna an ideal high-frequency antenna."[1] Dr. Terman, in *Radio Engineer's Handbook* says that when proper precautions are taken to reduce ground losses, the vertical antenna is an efficient radiator.[2]

What Amateur Users Say

In the following paragraphs, the opinions expressed are based upon personal experience and observation and conversations with hams who had taken some pains to achieve reasonable results from their antennas, whether they were vertical or horizontal, as well as on the footnoted and other articles.

On the 3.5 to 4-mc band, one W8 reported, "The vertical worked fine on DX—I got S9 reports from South Africa, but my reports from U.S. stations were definitely weaker than with the old horizontal antenna. As I work the U.S. every day and South Africa about twice a year, I put the horizontal back up." Another ham questioned said, "after trying a vertical, I can say that the worst horizontal antenna I ever used will outperform any vertical antenna made." A third ham said, "I must be satisfied with my vertical; I took down all my other antennas." On the average, a 3.5-mc vertical antenna is superior to a horizontal antenna over distances in excess of 850 miles, especially if the horizontal is less than 60 feet high. Conversely, the horizontal may be several S units better over shorter distances.

On 7 mc there is little to choose between a good vertical antenna and a good horizontal antenna for working long-haul DX—provided that the horizontal is 67 feet high.[3] But compared to lower horizontal antennas, the vertical is a better DX antenna. On the other hand, the horizontal usually works rings around a vertical over shorter distances. In fact, it was practically a waste of time to call stations within 500 miles or so with my vertical antenna, although the 23-foot high horizontal usually did very well over these distances. But as soon as "skip" lengthened out, results with the two antennas was just reversed.

Even on 14 mc, a low horizontal antenna usually outperforms a vertical over "short-skip" distances. But, once again, the vertical usually forges ahead of the horizontal over distances beyond 1,000 miles, at least until the horizontal antenna is a minimum of 50 feet high. And occasionally, the vertical will even outperform a horizontal beam on DX—just often enough to thrill the vertical owner and shake up the beam owner. On the 21 and 28 mc bands, there is little to choose between the two types —if the horizontal is at least 45 feet high.

Incidentally, a vertical antenna is fine for working mobile stations within ground-wave range. Conversely, cross polarization effects between horizontal and vertical antennas can reduce signal strengths as much as 23 db over these distances, although the difference is seldom this great. Don't worry, however, about cross polarization effects on signals that travel through the ionosphere. The trip so mixes up the polarization that there are equal amounts of both in received signals, without regard to their original polarization.

Installing a Vertical Antenna

According to some ads, a vertical antenna and a few square inches of space will solve most ham antenna problems. True enough, a vertical antenna installed in a crowded space will accept rf power and radiate part of it, the exact percentage depending largely on the ground losses under and near the base of the antenna. In addition, a ¼-wave or shorter vertical antenna radiates its strongest signal from the bottom third of its length; consequently, objects such as trees, buildings, and utility wires within a wavelength or more of the antenna will absorb part of the power radiated. They will also distort the theoretical circular radiation pattern of the antenna.

In this connection, the possibility of getting the antenna above some of the "crud" is the main advantage to a ground-plane antenna on frequencies where line-of-sight communications are unimportant. On the VHF bands, however, antenna height is a major factor in determining the communication range.

Unfortunately, a ground plane antenna is not easy to erect on frequencies below 14 mc. Even if you can stand a radiator of the appropriate height on your roof, where are you going to find room for the necessary ground-plane radials? You can reduce their length by installing loading coils in them, or you can zig zag them around in the available space—at the expense of lowered antenna efficiency.

"But what about mobile antennas," you may reasonably ask. "They use the car body as the ground system, and there are lots of mobiles on 75 meters." Passing over the 3% efficiency of the average 75-meter mobile antenna,[4] it is certainly possible to put a wire mattress the size of an automobile under a vertical antenna to serve as the ground system. In fact, one well-known antenna manufacturer

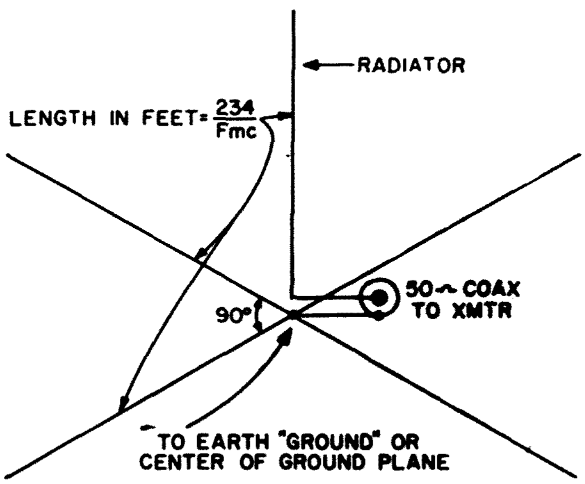


Fig. 3

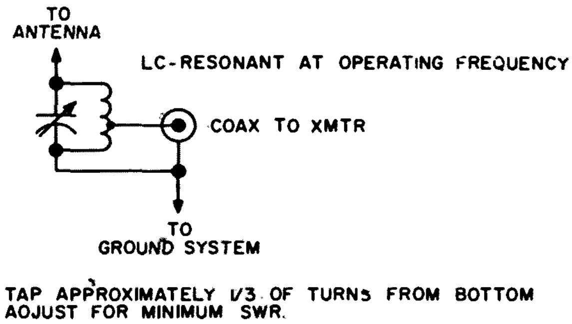


Fig. 4

will sell you the "mattress."[5] Its efficiency as a ground plane is proportional to its size compared to a full-size ground plane; therefore, its efficiency is high on 14 mc and above, and relatively low on 3.5 and 7 mc.

Lowering Ground Resistance

Returning to earth-mounted verticals, you could obtain a good ground connection in the center of a salt marsh by dropping a length of wire in the water. In rich, permanently-moist soil, driving an eight to 12 foot pipe about an inch in diameter into the earth will produce a fairly low-resistance dc or low-frequency ac ground return. In dry, sandy, or rocky soil four additional pipes in a 10 foot square around the first one, all five connected together with heavy wire is recommended. Such an installation is good for lightning protection, but it isn't a particularly effective rf ground.

Actually, rf currents are introduced into the earth for many feet around an antenna. As a result, these currents must travel long distances through the earth to reach the ground-return point of the antenna system. Furthermore, because of rf "skin" effects, the effective ground resistance increases with frquency.

To obtain a low-resistance, rf ground, in addition to the ground rods, you can bury four or more heavy wires a few inches in the ground like spokes of a wheel around the base of the antenna and tie them together at the center. For the best results, each buried radial should be at least ¼ wavelength long at the lowest operating frequency of the antenna. Also, the more radials you bury, the better the results, although the rate of improvement goes down after about 12 are installed.

Before treatment, the rf resistance of an average earth ground will be 50 ohms higher. With the installation of a buried radial system, this resistance can be reduced to less than five ohms. As a ¼ wave vertical antenna has an effective radiation resistance of approximately 32 ohms, lowering the ground resistance from

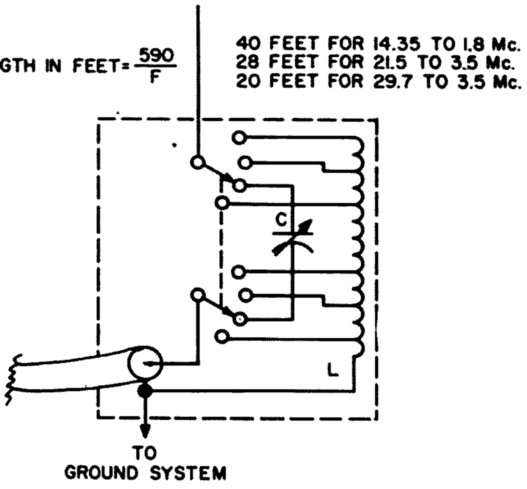


Fig. 5. Simple 3 to 5 band vertical antenna.

50 ohms to five ohms will increase the radiating efficiency of the antenna from 39% to 86%.

An even more dramatic improvement is obtained by reducing ground losses when a shortened antenna is used. For example, a ⅛ wave, loaded vertical (33 feet long on 80 meters) has a radiation resistance of 10 ohms or so. With such an antenna, reducing the ground resistance from 50 ohms to five ohms will raise the antenna efficiency from an anemic 17% to a respectable 67%.

By the way, if you don't have room for ¼ wave radials, shorter ones will still bring down the ground resistance. Increasing their number will help compensate for their lack of length. In one installation, sixteen 25 to 40 foot radials decreased the ground resistance from 50 ohms to 7.6 ohms at 4 mc.[6]

To give you all the bad news at once, even if all the local losses resulting from an imperfect ground were eliminated, this doesn't mean that the resulting antenna would necessarily be as good as one located where natural ground losses were less. Actually, the characteristics of the earth for miles around an antenna can affect its radiation characteristics.

Signals radiated at very low angles from an antenna graze the earth's surface, and over the best posible earth, energy radiated at angles below 3½ degrees is absorbed within a few miles. Over a lossy earth, energy at angles up to 10 degrees can be absorbed in this manner. The dotted lines at the bottom of the curves in Figs. 2A to 2D show the effects of this attenuation over an average ground. Fortunately, the power loss in this manner is not too high, simply because practical antennas just don't radiate a very great percentage of their power at very low angles. Nevertheless, the effect is present.

No dotted lines are shown in Fig. 1A to 1D, because, at the heights shown, horizontal antennas just don't radiate any appreciable power at angles below five degrees.

Practical Vertical Antennas

If you have stuck with me so far, you now have a pretty fair idea of the good and bad points of vertical antennas; so let's put up a few on paper.

Probably the simplest effective vertical antenna is the ¼ wave coaxial-fed one illustrated in Fig. 3. Fed with 50 ohm coaxial cable, the feedline swr will be approximately 1½ to 1 at the antenna's resonant frequency. If the antenna is being operated as a "ground plane," dropping the ends of the radials to produce a 30 degree angle below the horizontal (eight feet for a 16½ foot radial) should bring the line swr down to near 1 to 1.

Connecting a tuned circuit between the base of the antenna and ground as detailed in Fig. 4 will permit using the antenna on twice the frequency, also with low feedline swr. However, if the antenna is a ground plane type, you will probably have to add at least one pair of radials ¼ wave long at the new frequency to obtain mimimum swr there. In fact, this is one of the secrets of obtaing best results from a multiband vertical ground plane antenna—use a full set of four ¼ wave radials for the lowest frequency band and at least a pair of them ¼ wave long at each additional frequency band being covered.

Referring to Fig. 5, an antenna ⅝ wavelengths long at the highest frequency you wish to operate will perform efficiently over a 4 to 1 frequency range and fairly efficiently over an 8 to 1 range.

Careful positioning of the taps on the loading coil will produce minimum swr on all except the second highest frequency range of the antenna. At this frequency, the series capacitor will produce a lower feedline swr than taps on the coil. Incidentally, at 1,000 watts transmitter input, a current of five to eight amperes (depending on the frequency) will flow at the base of the antenna. Therefore, don't skimp on the switch, if you run high power.

An obvious disadvantage of a multiband antenna such as shown in Fig. 5 for quick-change artists, who like to flit from band to band, is the necessity of visiting the antenna for each band change. A more convenient method of covering several bands with a single antenna is to use a "trap" antenna. The "traps" are actually lumped circuits connected in series with the antenna at strategic points. They auto-

matically change the electrical length of the antenna as the operating band of frequencies is changed.

While you can get into a debate over how efficient a multifrequency trap is, its operating convenience can't be disputed. The "trap" vertical is available from several manufacturers, as are the raw materials for the other antennas mentioned.

Conclusions

A properly installed vertical antenna is an excellent ham antenna. However, its low-angle radiation characteristics make it somewhat a DX antenna. As a result, its operating performance may not please 3.5 and 7 mc operators who prefer to make solid contacts over short and moderate distances to squeezing out the last mile from every call. But with the predicted course of the sunspot cycle, for the next several years, low-angle radiators are going to be at a premium for night-time operation on both 3.5 and 7 mc.

If you are unable to take the extra steps to reduce ground losses and to get a vertical antenna away from power-absorbing objects, experience indicates that you might do better with a horizontal antenna. But bear in mind that a low-loss ground under it never hurt a horizontal antenna, nor does stringing it amidst utility lines and metal-frame buildings help a horizontal.

. . . W9EGQ

Fig. 5 Notes

L 40 turns #12 wire 6 tpi, 2½ dia. taps adjusted for min. feedline SWR.

C used on 2nd highest freq.—250 mmfd variable for 7 mc, 150 mmfd for 21 or 14 mc (may be omitted and coil tapped on these bands at cost of somewhat higher swr).

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6. **The Truth About the Vertical Antenna**, B. W. Griffith, W5CSU. QST, May, 1952, page ??.

Say you saw it in

7 3

even if you didn't.

Further on The Windom

In the past few months the old single-wire-fed Hertz antenna, so popular in the early '30's, has become an object of fresh interest.[1,2,3] The Europeans have appreciated it right along. The English, I believe, named it "Windom" after Loren G. Windom W8GZ, who introduced the design to the amateur fraternity in his famous 1929 QST article.[4]

Like the most recent author, Drayton Cooper W4WXY,[1] I have an affection for this elegantly simple way of radiating electromagnetic energy. The article left openings for further contributions in the following areas:

1) How to find the fundamental frequency of the antenna
2) How to find the correct point of feed
3) How to couple to a push-pull PA
4) A more complete bibliography

These topics are easily disposed of to complete the record.

At almost exactly the same time as Loren Windom's article in QST, Everitt and Byrne published a description of the single-wire-fed Hertz in Proceedings of the IRE.[5] This article does an excellent job of explaining topics (1) and (2) above.

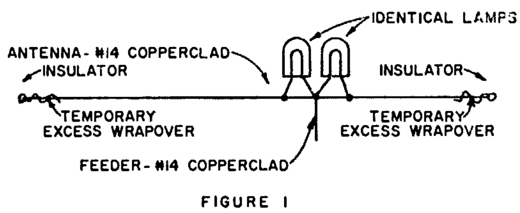

FIGURE 1

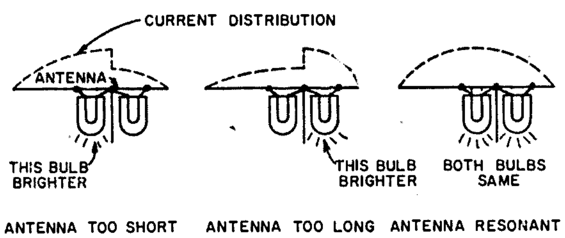

FIGURE 2

There is a very simple way to tune a single-wire-fed Hertz antenna. The practical technique was shown to me by Charles W. Sumner W4EJ in 1932. The technique as then employed was as follows for a 7-mc-fundamental antenna.

First, several Christmas-tree lamps were stripped of their paint. A matched pair was found by running them with a battery or a filament transformer. The glow was matched in dim light at an orange-red temperature. A lead 4 inches long was soldered to each terminal of each of the two bulbs selected. The bulbs were then attached across a small length of the antenna, with their common point at the attachment of feeder to antenna, as shown in Fig. 1. The antenna was then raised, preferably at dusk or at night, by means of rope and pulleys. Power in the order of 50 watts was applied. One bulb would usually be found to glow more brightly than the other. This indicated incorrect resonance, in accordance with Fig. 2. It was customary to leave about two feet of wire excess twisted at the insulator at each end of the antenna. A few inches of this added or subtracted at either end of the antenna (it makes no difference which end) tended to equalize glow of the lamps. Note that the feeder has not yet been matched and that this is unimportant at this point in the procedure. The length of the antenna was tailored in increments eventually down to about two inches until an equal lamp glow resulted. Fastidious operators would then interchange the lamp positions as a check that rf sensitivity was identical. Of course, the natural resonance of an antenna depends to some extent on its mutual couplings with other objects, including the earth and the feeder. Therefore the resonance as found by this method was often a few inches different from that given in the customary tables and formulas.

The bulbs should be removed when pruning has been completed. If you have meters and perhaps a transit—they're better. See the literature formulas.[4, 5]

Having resonated the antenna, the correct point of attachment of the feeder could be found. This was done by first dipping the plate current of the transmitter final amplifier with no load. The feeder was then coupled to the tank at some point, say 15 percent from the ground end of the plate tank circuit. The PA was redipped. It was carefully noted in which direction the dip had moved. The antenna was lowered and raised with new trial feeder positions until a point of attachment for the feeder was found which resulted in no change between tuning of the loaded and unloaded dip. If the transmitter happened to be a self excited oscillator such as the then popular TPTG or TNT circuits, then frequency of the oscillator output could be watched rather than tuning of the dip.

For a thorough job, another step is necessary to assure a "flat" line. There is always a remote chance that by the method above, a fortuitous resistive characteristic, dependent on feeder length, has been found. The proving-out step might be either of the following. (a) Carefully shunt three matched lamps at $\lambda/8$ intervals along the feeder. They should light with equal brilliance. (b) Temporarily add a $\lambda/4$ length of feeder. The tank tuning and loading should not change markedly. When you consider how many of these antennas have been put up by measurements from tables alone, "forced in" by matching networks at the transmitter, and with happy end-results, this last step may seem a gilding of the lily.

As W4WXY has already mentioned, it was important to have a good ground. Without it, rf might appear on nearly all the hardware connected to the ac Line in the shack. It was very annoying to receive small skin burns from metal receiver-tuning dials, for example. The best ground rods were, and still are, available from Graybar. One good type is 8' x ⅝" diameter, copperclad. If nearby, the home water pipe at its point of emergence from the ground is probably a better ground. A length of RG-8, or almost any coaxial cable, makes a good, low inductance ground lead. Only the outer conductor is used.

The wire for the antenna was usually No. 14. I made the mistake, one time, of using

soft-drawn (magnet) wire. It just kept stretching and stretching. The best kind is copperclad. If you have a kink, scrap it and start over.

One seldom-mentioned advantage of the single-wire feed Hertz is that it is not immediately apparent to the public as a transmitting antenna. That is, the amateur is less liable to harassment from TV viewers who may mistakenly attribute their troubles to his activities.

Now as to topic (3) above—there is nothing to it. For coupling to a push-pull PA, just tap the single wire up, either way, from the center tap of the plate tank. Mutual couplings in the coil and the tank circulating current will do the rest. It may look a little strange on the diagram, but there is no problem.

Incidentally, it is not proper to couple direct from the plate tank to the antenna. For one thing, this may make the antenna a lethal structure. In the early '30's it was common to put a 0.001-mfd capacitor in series with the lead. The tank was often made of ¼-inch copper tubing. Coupling adjustments were easily made by moving a small battery clip, attached through the 0.001-mfd capacitor to the single-wire-feed. Probably persons other than myself have made the mistake of holding a metal key down with one hand and reaching with the other to this tap to increase coupling. It is a mistake not soon forgotten.

Resonance is not precisely the same for harmonic operation of the antenna as for fundamental operation. The reasons for this are mainly that end-effect and mutual couplings to external objects, including the earth, are different. Therefore, adjustments are optimized for the band of most interest.

Tap adjustment is considerably different for harmonic operation from that for fundamental (half-wave) resonance. This is because current distribution, and impedances along the radiator, vary in a different way. While orthodox operation, with "flat" feeder, does not generally occur when harmonic operation is employed on an antenna system which has been optimized for fundamental-frequency operation, it has been possible to load these antennas at harmonics in somewhat the same fashion that random lengths of wire can be loaded. Although such operation is not as tidy as at fundamental resonance of the antenna, there have nonetheless been numerous satisfied users. At frequencies below half-wave resonance, the antenna can be worked against ground as a top-loaded Marconi.

The long-wire directionality features of harmonic operation of the single-wire-fed Hertz are doubtful, because of feeder radiation and attendant pattern distortion. If realized, some idea of magnitude of these effects is given by the following table, which is for radiators in free space.

	Angle of main lobe with respect to antenna axis	Gain relative to isotropic radiator	Gain relative to $\lambda/2$ antenna
Fundamental	90°	2.1 db	0 db
2nd harmonic	54°	2.5 db	0.4 db
3rd harmonic	42°	3.0 db	0.9 db
4th harmonic	37°	3.4 db	1.3 db
6th harmonic	30°	4.3 db	2.2 db
8th harmonic	27°	5.2 db	3.1 db

These characteristics assume that the feed does not radiate. They are listed because W4WXY mentions long-wire features of har-

monic operation. There are references in the ARRL Handbook, and other literature.[6]

When H. H. Washburn W3MTE was thinking about the Gamma match, prior to publishing his article,[7] he asked "Why not let the antenna balance itself?" He was referred to the single-wire-feed literature. No doubt he would have introduced his Gamma-match anyhow—but he probably felt encouraged.

I am indebted to Dr. Everitt and Mr. Byrne and also to Mr. Windom, for their correspondence in connection with the preparation of this article.

A bibliography for those who wish to read further completes this effort. No doubt some reader could add more from the archives of the old faithful single-wire-fed Hertz.

. . . W3AFM

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(W2NSD from page 6)

could come up with better reasons than individual amateurs in their comments.

The reaction, as reflected in QST, seemed to me to be one of hush-hush, hoping that the membership wouldn't notice what had happened. The docket was printed in the usual mice type and the editorials stepped up the stress on the ARRL being the representative of the amateur. Behind the scenes the policy seemed to be for the ARRL to oppose each and every rule change proposed by any individual or group. This had the result of dragging on rule making processes for unbelievable lengths of time.

There may have been some exceptions that escaped me, for I still was very loosely connected with the internal doings of our hobby at the time, but I got the distinct impression that for quite a few years the ARRL struck out just about 100% of the time. Every time they opposed legislation it went through, and every time they proposed changes they were defeated. The pendulum had indeed swung the other way for them. They lost on such matters as the forty meter phone band, RTTY on the lower frequencies, the forty meter Novice band, etc.

In view of these events I was rather surprised to find so little on the subject in CQ, the only other voice in the hobby. After talking with Perry I began to understand. He had tried time and time again to bring out some of the information , but had ben met by an unbelievable wall of emotional reaction from thousands of staunch ARRL believers who didn't want to know what was going on. To them it was as if God had been attacked. And among these thousands of fierce believers there were quite a few advertisers. The handwriting couldn't be clearer . . . shut up. This is why you have read virtually nothing about the ARRL in the amateur press, unless you happened to subscribe to W3NL's Autocall out of Washington . . . Andy didn't have to worry about advertising.

Aha, you say, now Wayne Green has revealed himself, he is really anti-ARRL. We knew it all along. Well, I'm not anti-ARRL, whether you want to believe this or not. Despite errors and biases on their part, our hobby would not have flourished as it has without their efforts.

Without their direction I doubt if we would have the thousands of amateurs eagerly sending messages through the immense traffic networks which we hear from 3600 to 3700 kc (and elsewhere). The whole framework of DX'ing and DXpeditions is founded upon the ARRL DXCC. Without this incentive we might throw thousands of DX hunters out of work. The ARRL QSL bureau has made it possible for thousands of DX stations to send QSL's to U. S. stations that otherwise surely couldn't possibly have afforded the tremendous postage expense involved. And so on . . . down through the long list of ARRL services.

And most important of all, ARRL is a gigantic publishing house, taking in well over a million dollars a year. Where would we be without the Handbook, How to Become an Amateur, etc.? Where would ham radio be without QST? Nothing like we have today, I suspect.

It is of course possible that I have misinterpreted some things down through the years. Perhaps you have some facts which will throw some light onto matters that I have either missed entirely or have not been fully informed on. I am much more interested in having all amateurs enlightened than I am in foisting off my own opinions on things.

The Trip

We've got about 80 signed up for the trip so far and have room for about six more. We'll all be leaving from Idlewild on Sunday October

6th in the evening and flying via Manchester to London by Sabena Airlines, arriving Monday morning. After four days of sightseeing and visiting the British amateurs we will zip on over to Paris (Thursday the 11th) for four days there. On the 16th we fly to Geneva (4U1ITU now can make phone patches) and the 19th to Rome. If you pay a visit to Smon and the Vatican you can count this as three countries. We fly up to Berlin on the 24th via Frankfort. Included here will be a tour of East Berlin (another country!) and then back to Idlewild on the 28th for a magnificent three week vacation.

The cost of the whole trip, including all fares is less than the usual round trip fare to Europe, which shows why it pays to travel in groups. Our group will be all hams and we'll visit as many amateurs as we can in Europe. If you're interested in going please let me know as soon as possible. You can cancel your reservation up to 30 days before the trip for a full refund of your $550.

No National Convention

An announcement came in the other day from the Cleveland Convention committee stating simply that due to unsolvable problems the ARRL National Convention would not be held there this year.

In QST (July page 16) we find that "insurmountable difficulties in compiling a program schedual adequate to meet the requirements for approval of the League" was responsible. This means that the committee was adament about some part of their program and the League refuser to approve the convention as an ARRL function as a result. The League insists on having the final say on convention programs as I have discovered in the past when I had been invited to speak by conventions and then, sometimes after I had traveled coast-to-coast, I would be uninvited because the League wouldn't permit it.

My recent mail has, I suspect, brought out the explanation of the difficulty QST was referring to. It apparently has to do with that purveyor of emotional trivia and manufacturer of certificates for sale: K6BX. Apparently the brutal and senseless assasinations of the ARRL in his columns have gotten far under the League's skin. Frankly I am surprised and disappointed if it is true that the Cleveland gang put this testy old man on their program. It is a shame if this was really the factor that broke up the National Convention. CQ can be proud.

(Turn to page 82)

W2SND from page 81

Swifties

The emergence of "Swifties," as reported recently in Life and Newsweek, has added a little sparkle to my QSO's. For those of you who read only ham magazines I'd better clarify.

Back when I was seven I got to reading a comic book called Jack Swift. In a short time I had been converted into a science fiction fan, a mental disturbance from which I have never recovered. The daily strip wasn't enough for a space hungry lad, so I rushed to the library in search of more Jack Swift. The closest they had was Tom Swift. Well, they had the same last name, so what the devil, I took out as many Tom Swift books as I could and read avidly. Frankly, it was a letdown from Jack Swift, but Tom had a stupid charm all of his own and I quickly read the entire series. You can't really expect a seven year old to be very selective in his reading.

"Now, to the meat of the matter," said Tom hungrily. Tom rarely spoke without dragging an adverb after him. To manufacture a "Swiftie" you start with a phrase for Tom to say, then use an adverb that ties in with the phrase. For example, here are some that I've perpetrated on unwary six meterites lately.

"I've installed a new squelch circuit," said Tom quietly.

"CQ Contest," said Tom gamely.

"I'm using a Thunderbolt here," said Tom finally.

"I have a Mohican," said Tom at last.

"I'm using super-modulation," said Tom broadly.

"I'm running a Thor barefoot," said Tom lamely.

That should get you started, let the fractured adverbs fall where they may.

Portable One

Many fellows ask how come I am able to continue to use my W2NSD call even though I am apparently a rather permanent fixture in New Hampshire.

Simple, if you are at all familiar with the FCC regulations. My fixed location is in Brooklyn at the old family homestead. As long as I have a fixed location for my license I can hold it there. When I desire to operate portable all I have to do is send in a notice of portable operation stating when and where I am going to operate. This notice is good for only one year, so I have to send in a new notice for each year of portable operation.

Much as I dislike New York I do have to go down there on business and it is nice to have a permanent residence, complete with a small station, when I am there.

The real bone of contention though is the present FCC system of impartially dealing out calls. I've had W2NSD for some 24 years now and I am darned used to it. In the not too distant past it was possible to get your own call, if it was available, when you moved to a new section. In years gone by I've had W4NSD two times and W8NSD once. Right now W1NSD is available and I'd like to have it for operation up here in New Hampshire, but the present FCC rules do not provide for this and the FCC policy is not to grant this courtesy.

Things went wrong when the FCC started to reissue the "W" calls after they reached ZZZ a few years after the war. Up until this time you could always tell just how long a chap had been licensed by his call. Then, much to the horror of the old timers, one day there appeared some mighty squeaky voices with W9A–calls. Things got back on the track again when the "W" calls got filled up and the FCC shifted to "K" calls. But along about this time they decided not to issue any calls out of order and we began to find some old timers who had moved to a new district with "K" calls.

You want to meet someone that is really bitter about all this? Just look around the band for an old timer that has been in ham radio for forty years and has just received his WB2 call! Come on FCC, stop being so mean . . . .

Field Day

There seems to be some sort of damned contest every other week. We no sooner got through with the June VHF QSO Party than talk began to mount about Field Day. I'm an avoider of national institutions and Field Day has always been high on my list of national institutions to avoid.

Then the summer-help contingent arrived, containing therein one boy fevering with chronic contestitus. This guy had to operate in Field Day, even if he could only use a one watt rig and a regen receiver after working hours. Something that has gone this far unchecked has to be humored, so I compromised by taking the Drake 2B and 200V up on 73 mountain to our VHF spot and letting him put up an inverted V.

Friday night, just before the contest, our Antenna Specialists Zeus alternator arrived and we were thus all set for emergency power. The Zeus, by the way, is an amazing package.

One man can struggle the thing around and two can lift it and carry it easily. The one we got is rated at 3000 watts! We had gotten the Zeus primarily for use in the mobile unit, but this presented an ideal opportunity to break it in with a good long hard test.

By Saturday afternoon everything was set up. We would make a two-man job of it with me spelling the Boy Contestant when he pooped out. The generator was started up and we were almost blasted out of the room by the ignition noise! A quick test showed that all of the noise was coming in through the antennas and not the line, so we quickly moved the antennas from the immediate field of the Zeus. The six meter antenna quieted right down at about 20 feet, which was simple with the Hi-Par Hilltopper on a broomstick stuck in the ground.

The Zeus ran perfectly for the 24 hours of the contest, using about 10 gallons of low test gas in the process. We made some 500 plus contacts. Maybe next year we'll try planning things two days ahead instead of one.

Our Boy Contestant looked a little disappointed when the final seconds of Field Day ticked by, then he brightened and said, "Hey, there's an ARRL CD Party in two weeks!" I killed him.

An Epic in Frustration

One basic flaw in my shady character is that I *like* contests. This is bad. It influences the very fibres of my life. It did not escape me when I was deciding to move to New Hampshire that this is a fairly rare state radiowise. I had one eye on Pack Monadnock, a famous VHF location, when I decided to look for a house and settled 3½ miles from it.

I firmly believe in high places for VHF contests. I've packed two meter gear to just about every hill in New England at one time or another. Many old timer VHF'ers may remember me operating from the top of the News Building in New York and from the top of the Municipal Building. My 1948 score of 146 contacts in 10 sections on two meters (using a 522 barefoot) stood for quite a while.

Along about three weeks before the June ARRL VHF QSO Party this year I got to brooding and decided that we would make an effort and get in the contest. Since the 73 Hq building just isn't high enough to make it (as I discovered in last September's contest), the next best thing seemed to be a portable rig up on Pack Monadnock. Since I had enough equipment to make do all we needed for this was a bus and a generator. It shouldn't be hard

to get these two items in three weeks. It was.

While the dickering was going on over the generator I chanced to meet our Friendly (Porsche-pushing) Real Estate Dealer downtown. We got to talking about my persistent search for a piece of high ground to build on. He mentioned that he had a house up on Mount Monadnock for sale. I did a double-take and bore down hard for details.

By five days before the contest we owned a six room house over 2000 feet up on the mountain, and had managed to wipe out the bank account that the last real estate deal brought us. OK, I had the location, now all I had to do was bring up the equipment, set it up, put up towers, beams, etc. All this during the same week that we were closing the July issue of 73 and I had to leave on Friday for the Texas Convention!

The station planned would run 1000 watts on two and six meters and about ten watts on 220 mc. The antennas would be a 64 element two meter beam on a 60′ tower, a 16 element beam an another 60′ tower, and a 32 element beam for 220 fixed to the southwest on one of the towers.

The next four days were a frantic battle with the flies and mosquitoes, who were dead set against our antenna plans, and a myriad of equipment failures and low line voltage which threatened failure on the other end of things. By Wednesday I had worried my back out of shape again and could hardly walk, which eliminated my trip to Texas and disheartened Val, K1APA, who had planned to operate for the contest.

We were driven on by descriptions of the setup at W1BU (W1FZJ), where we were given to understand that Sam had set up little gadgets like a 128 element two meter beam on a 170′ tower, several fixed beams for six and two, 32 elements for six meters, and who knows what monstrosities on 220 and 432 mc.

As the contest started Saturday afternoon I had 500 watts on two meters, a Clegg Thor barefoot on six meters, and nothing working for 220. The antennas consisted of half of the 64 element two meter beam hanging from one tower (it was too windy to finish putting it up), the 16 element six meter beam on the lawn (pipe too small to support it, have to get heavier pipe), and the 220 beam spread out on the lawn. I was using a Hi-Par Hilltopper (6M) on a broomstick on the front porch and a Cushcraft Big Wheel for two sitting on a bench beside the Hilltopper.

And that was it. I operated through the whole contest with those two antennas out there on the porch.

Never Say Die.

The contest was a lot of fun, even so. From 2000 feet up you can work a lot of stations just with a piece of wet string for an antenna. Cushcraft's Big Wheel netted me 86 contacts with twelve sections on two meters. Conditions were not good on two so I didn't spend a lot of time with it. On six the Hilltopper turned in a sterling performance . . . 247 contacts in 31 sections. The transceiver operation of the Clegg Thor made a world of difference. If I had been rock bound I would have missed a great many contacts.

The next contest should be better. With a kilowatt and a 16 element beam on six I should get answers the first time instead of having to call ten or twenty times before getting through. I need the extra push here for we are over 200 miles from New York. I didn't hear one Boston station during the contest, so the only bulk supply of contacts is down New York way. Watch out in September.

Learning The Code

Perhaps the chaos in our Citizens Band can be taken as a warning to those well-meaning amateurs who are suggesting the elimination of the code requirement from the amateur license. Though the code serves only as a men from the boys separator for many seeking the amateur license, perhaps its continuance is validated by a monitoring of the CB frequencies, or even a monitoring of the far tamer, but still disturbing, six meter band.

Sometimes it is difficult to decide whether the arrogance of know-it-all youth is harder to take than the aggressive stupidity of crochety old men, both of which are prominently displayed on our bands.

Now about the code. An article came in recently from a chap with an approach to learning the code that was supposed to make it far easier and faster than any other previously used method. I've applied several earth-shaking new code methods to hopeful students in the past and have developed a great skepticism. In my experience a person is able to learn the code if he buckles down and studies it. It takes practice and more practice. That is the nice thing about the code . . . there *are* no shortcuts. This is a cohesive force for our hobby I expect. All of us have, at one time, been through this ritual of fire.

This new method . . . not very new really . . . is the learn while you sleep system. Now you can't ask for anything better than that, can you? Just think, all those thousands of

hours that we used to just throw away can be used profitably to learn code, foreign languages, etc.

May I be blunt? Hogwash!

There is not the slightest scientific evidence, despite many enthusiastic tests, to indicate that there is any benefit whatever to be gained . . . except to the purveyors of while-you-sleep-learn tape machines and tape courses.

It is entirely possible that someday we may be able to develop a system of learning along this line, but before that can become fact we have to do a lot more research on the mind. Just a fraction of the investment in space exploration devoted to finding out how the mind works would probably put us and mankind ahead tremendously.

In the meanwhile I think we can safely apply the universal rule that you don't get something for nothing. This is a cliché, I'll grant, and is widely disbelieved . . . but you can live a very happy life steadfastly refusing the multitude of pitfalls masquerading as something for nothings. Like sleep learning.

The problem is this. We are able to recall and evaluate only material that we have sensed with the conscious mind. While we know that everything heard or sensed while we are unconscious is recorded, we are so far only able to play back these recordings under hypnosis. Some of these recordings have an amazing effect upon our conscious life, but still they are not available to us as memories or for conscious use. Someday we may discover the patchcords to connect the sense-recording system into our conscious mind and then we will be able not only to free ourselves from our many subconscious compulsions, but will sport total recall.

Bit of Battle

Just in case my rather careful examination of the League's shakey position on incentive licensing last month didn't alienate my previous good working relationship with ARRL, I would like to discuss their dismal stand against amateur television. In amongst several pages of patriotic enthusiasm over amateur radio, extending in oratory almost to Motherhood and Apple Pie, we find that the ARRL is opposed to permitting amateurs from experimenting with narrow bandwidth television on the upper reaches of the six and two meter bands because of the present heavy use of these bands and anticipated future use of these bands.

Let us ignore the blow to the solar plexus of our hobby which they are dealing with their opposition to amateur experimentation.

Let us ignore their opposition to amateur responsibilities in the Public Interest, Convenience and Neccessity. Let us ignore the incredible distortion of fact about activity on two and six meters. Let us ignore the many dire warnings we have had that unless there is more activity on the higher parts of these bands that we might well lose them. Let us ignore the important technical advance that might be pioneered by amateurs in the development of a good workable narrow bandwidth television transmission system. Let us ignore the fact that outside of two or three fixed FM net frequencies that the top two megacycles of both six and two meters are virtually vacant. Let us ignore the fact that the ARRL opposed this TV petition without consulting the 84,000 members that they are officially speaking for. Let us ignore the rumors that opposition to this originated with one man on the Executive Committee and was then rubber stamped by the directors. Let us ignore that a poll of the readers of 73 was made which showed overwhelmingly the support of the proposal and the lack of any poll by the League of its members to determine their feelings. Let us ignore the importance of this proposal to the development of amateur television which is being held back seriously by the present limitation to 420 mc and above. Let us ignore the parallel between the development of television which would in all probability take place were it allocated frequencies on the upper portions of two and six and the amazing development of RTTY when it was permitted to operate on the lower frequency CW bands over the determined opposition of the ARRL. We should also ignore the important technical developments which have resulted from RTTY being permitted to operate in our low frequency bands, developments which have had vast application in military equipment and which might never have been made if the ARRL had succeeded in preventing RTTY from being used on the low frequencies. Let us ignore the whole thing and drop a note to the FCC, Washington 25, D.C., telling them that you are not one of the 84,000 amateurs that the ARRL is speaking for in their opposition to amateur progress. Reference this to RM-399, the petition to permit narrow band-width amateur TV on the top ends of six and two meters.

Stuff in the Mail

A little package arrived the other day from an outfit called Science Hobbies. It contained an envelope with eleven semiconductors in it

and a sheet of instructions on how to use them in a number of simple circuits. This seemed like a marvelous idea to me, but who the devil was Science Hobbies, were the semiconductors any good, would they be widely distributed, etc?

A flurry of letters clarified the situation. These silicon semiconductors are American made by a large manufacturer and though they are normally priced at $29.95 for the group, are being merchandised to sell for $2.98 as a package. The instruction sheet has circuits for making an automotive tachometer, a transistor regulated power supply, a 30 volt low current power supply, a 6 & 9v battery eliminator, a 1.5/9v battery tester, a dc voltmeter with overload protection, a photoelectric relay light energized, an audio oscillator, a photocell light meter, a transistor preamplifier, controlled rectifier, remote contactor, speech clipping and limiting, cathode biasing, and screen biasing.

Each semiconductor is color coded and all are different. For instance, in the automotive tachometer all you need is the yellow (twin anode 5-8 vdc diode), the green (single anode 8-25 vdc diode) and the blue (single anode 25-50 vdc diode) plus a 1000 ohm ½ watt resistor, a .47 mfd 10v condenser, a 0-1 ma meter and a 500 ohm calibration pot. Pretty simple, eh?

Since these semiconductor kits are obviously something that every amateur should be interested in I've made arrangements for the Bookshop to have them available (number 104).

Some of the construction projects look mighty tempting. I'll have Paul W1PYM, the keeper of our struggling kit department, work up a couple of parts kits for them.

Other Mail

Not all of the California schemes seem quite this practical. About 50 California hams took the trouble to send me a copy of a flier they received proposing that they join a club, dues only $10 a year, which would give them all sorts of unnamed benefits. The only specific things mentioned were a year's subscription to CQ (some benefit!) and free access to a ham station set up by a local distributor. The club was almost completely anonymous, with no names or calls being mentioned in the promotion piece. If this deal is legitimate then the chap who sent out the flier must be a nitwit.

(Turn to page 88)

(W2NSD from page 87)

Questions and Answers

The questions I get during talks at conventions and from visitors make it rather obvious that I am not going into enough detail on a lot of my editorial explanations of things.

Jim Demler WØDSU, here for the summer, had read the letter in VHF Horizons from me refusing to take advertising from them on the grounds that I didn't believe that their magazine would be successful. This was obvious to me and it really never occurred to me that many people could think differently. How did I know? Well, I know about what is costs them to print their magazine every month and approximately what their other expenses must be. All I have to do then is make a rough estimate of their income and see if the two match.

Making an educated guess, I calculated that they were taking in about $1000 a month, tops, in subscriptions, and maybe $600 in advertising. This would just barely cover the printing bill, leaving all other costs of running the business as a net loss. You don't run a magazine at a net loss for very long.

The basic miscalculation that I felt that they made was in believing that all VHF operators would welcome a VHF magazine. Unfortunately, a large percentage of VHF ops are running Twoers or equivalent and could care less about what the handful of VHF DX'ers are doing. As far as I know this estimate was accurate, if my information on the circulations of the VHF magazines is true. To the best of my knowledge VHF Amateur made it to just over 2000 circulation before giving up and disappearing into the back pages of CQ, as did VHF News before it. VHF Horizons made a more determined effort and, I believe, reached over 3500 VHF'ers. But you can't publish anything more than a bulletin with this order of magnitude or circulation.

Jim then wanted to know why, if these other magazines couldn't make it, we were going to start publishing a VHF magazine. First of all, as an ardent VHF man, I believe that communication is important to this field of interest and that there is a need for a monthly bulletin for VHF'ers. Secondly, with the setup we've got here we can pull the props out from under the normal printing costs of a magazine. We've got everything necessary for printing offset bulletins and small magazines: press, platemaker, huge process camera, art department, artist, etc. We can print a magazine and have it in the mail within three days, where the normal printer takes about two weeks.

We are particularly fortunate in getting Jim Kyle K5JKX, the previous editor of VHF Horizons, as our editor for VHF Magazine. Jim is not only the top writer in the ham radio field today, he also has a splendid background in VHF operating and a wide acquaintance among the top VHF operators.

We'll start off VHF Magazine as I did 73, cautiously and in the black. We're sort of figuring on hitting a peak of 5000 circulation, but are willing to be surprised. We'll try to have it chock full of good practical VHF information as well as the latest operating news that can be published. See page 93 for subscription information.

Inventive Licensing

During one of the many discussions of incentive licensing here at 73 HQ, Virginia made a point that might well be passed on. Basically it is this: There seems to be little correlation between formal technical training and inventive ability. Of what use is it for us to get the FCC to force everyone to learn enough theory to pass a harder exam? What can this accomplish? If we could present them with a test of their practical knowledge of the hobby, that might prove something. Virginia went through an embarrasingly long list of graduate engineers that we have met who have conclusively demonstrated themselves to be absolute dunderheads at ham radio. A look through the ham magazines showed us further that the bulk of the real advancements in ham gear have been made by formally untutored hams.

It has long be recognized in educational fields that the current emphasis on memorization is one of the best ways yet known to weed out the intelligent and inventive talent. Why apply a proven losing technique to ham radio by setting up a further memorization hurdle for all the General and Conditional licensees? The result of this would be the opposite of the claimed desire: we would lose a lot of the very fellows who are the most valuable to our hobby. Bah!

. . . Wayne

Buy 73 at Your Distributor

Roughly one third of the circulation of 73 is through the radio parts distributors. This is a good thing and we like to encourage it. About the only real drawback to it is that only a few distributors get enough copies each month to last all the way through the month. This means that quite a few amateurs miss out on copies. And even though we've tried everything we could think of to get all of the parts distributors to handle the magazine, there are still a lot of them that have never gotten around to placing an order.

If you find that your distributor has run out or doesn't stock 73 please let me know right away so I can put some pressure on him to do better by you. This will help a lot of other hams who might miss getting 73 too. Even if you are a subscriber I'd like to know if you have a dealer that doesn't have 73 available.

The next few issues will be selling out mighty fast, so maybe you'd do better to make sure you don't miss out by subscribing right now.

Name .... **Call** ....

Address ....

City .... **Zone** ...... **State** ....

☐ **$3.50 One Year** ☐ **$6.50 Two Years** ☐ **$9.00 Three Years**

☐ **$40 Life (yours or ours)**

50c each enclosed for the following back issues ....

(All 1960 issue $1)
(Jan. '61 out of print) **Class license** ....

☐ **$1.00 enclosed for one year membership in Institute of Amateur Radio.**

Send to: 73, Peterborough, N. H.

73 Products

Peterborough, N. H.

73 PUBLICATIONS

6 UP Magazine. Published monthly for all VHF operators. Includes latest operating news, technical data, improvements on commercial VHF gear, skeds. Editor is K5JKX. Mailed first class mail to all charter subscribers. $2.00/year.

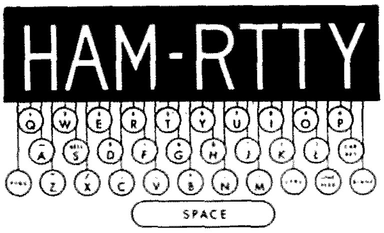
ATV Experimenter. Published semi-monthly for all amateurs interested in amateur television. Includes latest operating news, list of active stations, technical data, surplus conversions, latest FCC ham-TV news, etc. Editor is WØKYQ. $1.00/year.

Club Bulletin. Published ten times a year for all club officials and club bulletin editors. Includes news from club bulletins, latest FCC actions, info to help editors put out interesting club papers, info to help make clubs successful, etc. Editor is VE3DQX. $1.00/year.

Send subscritions to all 73 publications to 73, Peterborough, New Hampshire. Be specific, don't make us guess.

Bound Volume I & II, in stock $15.00 ea.

NEW RTTY BOOK $2.00

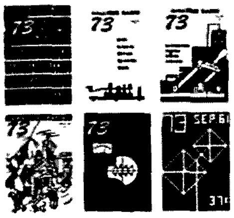


This handbook is written for the beginning RTTY op, but due to the profusion of info, pictures, circuits, etc., it will be valuable to all RTTY'ers and those who may RTTY themselves. If you don't know what RTTY means don't buy it. For $2 what can you lose? It's worth almost that much in paper.

BINDERS FOR 73 $3.00

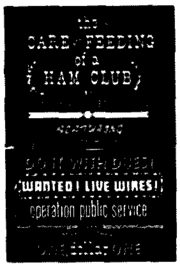
Keep your issues of 73 all in good shape and keep them from straying. Specify year: '60-61, '62, '63. Red Leather binder with gold stamped "73" and year. Darbs.

BACK ISSUES 50c



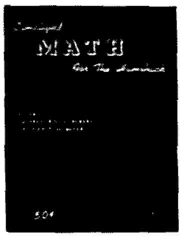
You can enjoy back issues of 73 just as much as current. Send for one each month to pad out those dreary days. All back issues now available except January 1961. Early issues going to $1 soon. Supply very limited.

CARE AND FEEDING OF HAM CLUBS $1.00



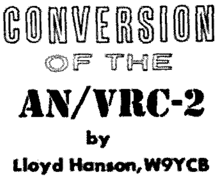
K9AMD's interesting book on all aspects of forming and holding together a ham club. This is the result of exhaustive interviews with many club officers and will be invaluable to every club going.

SIMPLIFIED MATH 50c

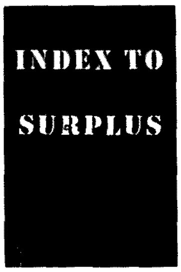


This booklet takes you gently by the hand and leads you through the mysteries of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc., and does it by an amazingly new method.

AN/VRC-2 CONVERSION $1.00



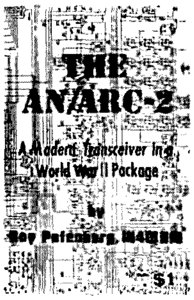
Exhaustively complete instructions on converting the surplus and inexpensive VRC equipment for six meter wide band FM ham net operation. Get thyself on 52.525 mc and join the national wide band FM activities.



INDEX TO SURPLUS $1.50

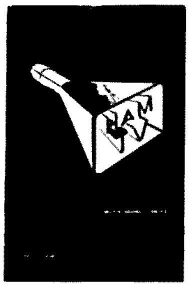
This is a complete list of every surplus conversion article that has ever been published, with a brief description of the conversion. Invaluable bibliography.

AN/ARC-2 CONVERSION $1.00



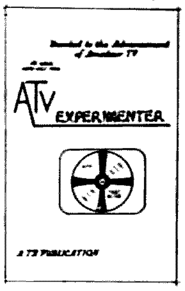
Complete schematics and thorough conversion details on this modern transceiver which covers 2-9 mc (80-40 meters . . . and 160). This unit now sells for $40 to $50 surplus and is easily converted into a terrific little transceiver.

HAM-TV $3.00



This book gives you a blow by blow description of how to get on the air on TV for under $50. This book is the reason that hundreds of hams are now going on TV. This is not the usual theory book, just a how-to-do-it manual.

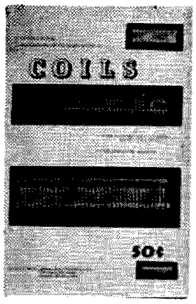
AMATEUR TELEVISION EXPERIMENTER $1.00 per year



The first six issues of this invaluable bulletin are now in print. Each one is worth more than the year's subscription. Send $2 for complete set from #1 up through #12. Quantity limited so don't wait.

SURPLUS TV SCHEMATICS $1.00

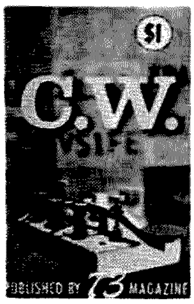
TV'ers who are interested in saving a lot of construction time and still want to have elaborate TV gear will do well to watch those surplus ads and invest in this booklet, the only source of the diagrams you'll be needing.



COILS 50c

Well illustrated basic book which describes all of the different types of coils to be found in radio work. Covers theory and practical aspects.

CW $1.00



Written by an expert. One of the best methods for learning the code yet devised. Lays in a good foundation for later high speed CW ability. CW can be a lot of fun if you go about learning it the right way. This book will be invaluable to the beginner and the ham who wants to really increase his code speed.

WORLD GLOBE (plus subscription for one year) $16.95

Every visitor to the 73 HQ shack is taken aback by the beautiful world globe next to the operating position. We find this invaluable for figuring out beam angles and planning world tours. It is 18" in diameter, normally sells for $19.95 (via CQ), is nearly five feet around the equator. Canadians please allow a little extra for Diefendollar exchange.

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

3 NUVISTOR 2M PREAMP. Mar 63 p8
W9DUT Kit $18.50

1 TUBE ½W QRP 40M XMTR. Mar 63 p22
W1MEL Kit $6.00

15-20M NUVISTOR PREAMP. Apr 63 p40
W6SFM Kit $4.00

ADJ. REG. XSTR P.S. Apr 63 p8
W1ISI Kit $25.00

VECTOR VFO. Apr 63 p24
W7IDF Kit $6.50

6M XSTR XCVR. May 63 p8
K3NHI Kit $25.00

6DJ8 6M CONVERTER. May 63 p11
WA2HVK Kit $17.50

COIL EVALUATOR. Jun 63, p20
WØQWY Kit $9.00

CW MONITOR. Jun 63, p44
WA2WFW Kit $4.25

TWOER MODIFICATION. Jun 63 p56
K6CJN Kit $6.50

HOT 6M CONVERTER. July 63 p8
W9DUT-2 Kit $20.00

TUNINC EYE KIT. July 63 p22
K6GKU Kit $7.50

2M ANT COUPLER SWR BRIDGE July 63 p32
W6TKA Kit $10.00

Radio Bookshop

Read Books and Prevent Incentive Licensing

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. $12.00

11—16TH EDITION RADIO HANDBOOK—by Bill Orr W6SAI. This fantastic book is loaded with the most understandable theory course now available in our hobby plus dozens of great construction projects. This is the best ham handbook in print by a wide margin. Easily worth twice the price. $9.50

13—REFERENCE DATA FOR RADIO ENGINEERS. Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. $6.00

16—HAM REGISTER—Lewis (W3VKD). Thumbnail sketches of 10,000 of the active and well known hams on the air today. This is the Who's Who of ham radio. Fascinating reading. Only edition. Now only $2.50

18—SO YOU WANT TO BE A HAM—Hertzberg (W2DJJ). Second edition. Good introduction to the hobby. Has photos and brief descriptions of almost every commercially available transmitter and receiver, plus accessories. Lavishly illustrated and readable.. $2.95

21—VHF HANDBOOK—Johnson (W6-QKI). Types of VHF propogation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. $2.95

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, to install it, how to tune it. $2.70

23—NOVICE & TECHNICIAN HANDBOOK—Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license and build a station. $2.85

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. $2.85

26—S9 SIGNALS—Orr (W6SAI). A manual of practical detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. $1.00

27—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction, and operation of cubical quads. Build-it yourself info. Feed systems, tuning. $2.85

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. $1.75

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. $7.50

36—CALL LETTER LICENSE PLATE—Regulation size license plate. Please give your call and the color of letters and background. $3.00

37—101 WAYS TO USE YOUR HAM TEST EQUIPMENT—Middleton. Grid-dip meters, antenna impedance meters, oscilloscopes, bridges, simple noise generators, and reflected power meters are covered. Tells how to chase trouble out of ham gear. 168 pages. $2.50

52—HOW TO READ SCHEMATIC DIAGRAMS—Marks. Components & Diagrams; electrical, electronic, ac, dc, audio, rf, TV. Starts with individual circuits and carriers through complete equipments. $3.50

53—BASIC ELECTRONIC TEST PROCEDURES—Turner. This book covers just about every possible type of electronic test equipment and explains in detail how to use it for every purpose. Testing: audio equipment, receivers, transmitters, transistors, photocels, distortion, tubes, power . . . etc. $9.75

55—TRANSISTOR CIRCUIT HANDBOOK—Simple, easy to understand explanation of transistor circuits. Dozens of interesting applications. $4.95

63—GE TRANSISTOR MANUAL—6th edition. This is one of the best buys around: 22 chapters, 440 pages, diagrams by the gross, data, facts, charts, etc. If you don't have this one you just aren't up to date. only $2.00

66—DESIGN MANUAL FOR TRANSISTOR CIRCUITS BY CARROLL. Tested transistor circuits for design engineers. Interesting reading too. $9.50

SPECIAL SPECIAL SPECIAL
Radio Handbook, 15th Edition, written by Bill Orr W6SAI, over 800 pages. Covers every phase of amateur radio from the very basics right up through the construction of just about everything you could want in ham gear. Originally published at $8.50. Superceded by the new 16th edition which is the same except for new construction projects and selling for $9.50 (see number 11). Special, until the last few copies are gone, only $5.95!

67—TRANSISTOR CIRCUIT ANALYSIS AND DESIGN by Fitchen. Written primarily as a college text to teach circuit design. $13.00

68—HANDBOOK OF TRANSISTOR CIRCUIT DESIGN BY PULLEN—This is a handbook which teaches a systematic system for transistor circuit design. Highly recommended by radio schools. $13.00

74—HANDBOOK OF ELECTRONIC TABLES & FORMULAS—Formulas & laws, constants, standards, symbols and codes. Math. tables, misc. data. $2.95

76—MODERN OSCILLOSCOPES & THEIR USES—Ruiter. Second edition. Shows what a 'scope is, what it does and how to use it for radio, TV, transmitters, etc. 346 pages. $10.20

80—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. 1 (second edition). This book gives circuit diagrams, photos of most equipment, and rather good and complete conversion instructions for the following: BC-221, BC-342, BC-312, BC-348, BC-412, BC-645, BC-946B, SCR-274N 453A series receivers conversion to 10 meter receivers, SCR-274N 457A series transmitters (conversion to VFO)SCR-522 (BC-624 and BC-625 conversion to 2 meters), TBY to 10 and 6 meters, PE-103A, BC-1068A/1161A receiver to 2 meters, Surplus tube index, cross index of A/N tubes vs. commercial types, TV & FM channels. $3.00

81—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. II. Original and conversion circuit diagrams, plus photos of most equipments and full conversion discussion of the following: BC-454/ARC-5 receivers to 10 meters, AN/APS-13 xmtr/rcvr to 420 mc, BC-457/ARC-5 xmtrs to 10 meters, Selenium rectifier power units, ARC-5 power and to include 10 meters, Coil data-simplified VHF, GO-9/TBW, BC-357, TA-12B, AN/ART-13 to ac winding charts, AVT-112A, AM-26/AIC, LM frequency meter, rotators, power chart, ARB diagram. $3.00

82—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. III—Original and conversion diagrams, plus some photo of these: 701A, AN/APN-1, AN/CRC-7, AN/URC-4, CBY-29125, 50083, 50141, 52208, 52232, 52302-09, FT-ARA, BC-442, 453-455, 456-459, BC-696, 950, 1066, 1253, 241A for xtal filter, MBF (COL-43065), MD-7/ARC-5, R-9/APN-4, R23-R-28/ARC-5, RAT, RAV, RM-52 (53), Rt-19/ARC-4, SCR-274N, SCR-522, T-15/ARC-5 to T-23/ARC-5, LM, ART-13, BC-312, 342, 348, 191, 375. Schematics of APT-5, ASB-5, BC-659, 1335A, ARP-2, APA10, APT-2. $3.00

83—THE SURPLUS HANDBOOK, VOLUME I—Receivers and Transmitters. This book consists entirely of circuit diagrams of surplus equipment and photos of the gear. One of the first things you really have to have to even start considering a conversion of surplus equipment is a good circuit diagram. Tihs book has the following: APN-1, APS-13, ARB, ARC-4, ARC-5, ARN-5 VHF, ARN-5, ARR-2. ASB-7, BC-222, -312, -314, -342, -344, -348, -603, -611, -624 (SCR-522), BC-652, -654, -659, -669, -683, -728, -745, -764, -799, -794, BC-923, 1000, -1004, -1066, -1206, -1306, -1335, BC-AR-231, CRC-7, DAK-3, GF11, Mark 11, MN-26, RAK-5, RAL-5, RAX, Super Pro, TBY, TCS, Resistor Code, Capacitor Color Code, JAN/VT tube index. $3.00

88—EUROPE ON $5.00 A DAY—Europe can be just as expensive as the U. S. unless you know where to stay and where to eat. This book is the standard reference work for European travelers on a budget. This is the latest edition. **$1.95**

91—DIETZGEN 10" SLIDE RULE—This is the slide rule that is recommended in the book, "Simplified Math For The Ham Shack." With a little practice you'll have Ohm's Law whipped, and any other calculations too. Has C-D-CI-L-T-A-B-S-K scales. Beautifully made rule, complete with plastic case, looks like five times the price and works that way too. **$2.85**

92—QSL DISPLAY PLASTIC POCKETS—Each set of clear plastic pockets holds twenty QSL's for wall display. Keeps cards flat, clean and perfect. Keeps walls clean too. Or have you tried to hang QSL's yet. This beats thumb tacks and Scotch Tape all hollow. Comes in envelope of three to hold 60 QSL's, give it a try and you'll never use anything else. **Three: $1.00**

93—RADAR-TECTOR—This gadget, though designed to pick up police radar (which it does very efficiently we are told by several amateurs), also picks up two of our amateur UHF bands. Operates entirely from the 12v car battery. Regular price is $44.95. Bookshop Special **$28.95**

94—KIT OF SOLDERING TOOLS—Used to was a soldering iron was all that was necessary, now you have to have a kit of fool tools. Little doohinkies like scrapers, reamers, forks, and brushes. Forsooth! Made of varnished maple and spring steel (vastly superior to winter steel). **$4.87**

95—NE-PAD—Pilot-type writing desk that elastics to your pants leg for mobile log-keeping. Complete with two pads of 50 special 73 mobile log sheets. You know the logs gotta be good. Extra log pads are only 25c a pad. Ne-Pad with two log pads **$3.95**

96—LATEST CALLBOOK—There are so many changes in the Callbook that you should plan on buying a new one at least once a year.
USA Callbook **$5.00**
Foreign Callbook **$3.00**

97—RADIO AMATEUR DX GUIDE—Crammed with maps, time conversion tables, great circle charts, etc. Each page may be removed for mounting on wall. **$2.00**

98—WORLD PREFIX MAP—Printed in four colors on heavy stock for wall mounting. 29" x 42". Has country prefixes, time zones, radio zones, and alphabetical listing of prefixes. **$1.00**

99—RADIO AMATEURS WORLD ATLAS—16 pages in four colors. Shows all six continents, West Indies, country prefix list, etc. If you work any DX this atlas will be very helpful. **$1.00**

100—ELECTRONIC CONSTRUCTION HANDBOOK by W8MQU. Covers all sorts of info on how to build. **$2.95**

102—CALL-D-CAL. Your call letters and state on a large decal (8½" long) in five colors. DX calls on world globe. **$1.95**

103—"SCOTCHLITE CALL." White letters on black background. Pressure sensitive to stick anywhere. 8½" long. Don't forget to give your call letters when ordering. **$2.00**

105—THE PHILLIPS CODE. A tested method of code shorthand used since 1879 by landline ops. See page 88, March 63 issue of 73. **$2.75**

ACR-1—ABC'S OF CITIZENS BAND RADIO—by Buckwalter. How to choose, set up, license and operate CB equipment. Discusses different types of rigs, receivers, antennas, how to tune, install, operate and troubleshoot. **$1.95**

ALP-1—GENERAL CLASS LICENSE HANDBOOK—by Pyle W7OE. A complete guide including typical questions and answers, to help you prepare for the FCC Technician, Conditional or General amateur radio exam. A good writer is quite a help in this sort of thing. **$2.50**

AMA-1—AMATEUR RADIO ANTENNA HANDBOOK—by Hooton W6TYH. Basic theory, construction and tuning of all the well known and effective ham antennas. Good stuff on feed lines and towers too. **$2.50**

AMP-1—TROUBLESHOOTING AMATEUR RADIO EQUIPMENT—by Pyle W7OE. A guide for all hams who want to keep their gear on the air by themselves. Includes complete schematics of many popular ham transmitters and receivers. **$2.50**

AMR-1—ABC'S OF MOBILE RADIO by Martin. Covers subject of two-way FM mobile operation. Equipment, control, range, power supply, receivers, transmitters, installation, and uses. Quite comprehensive. **$1.95**

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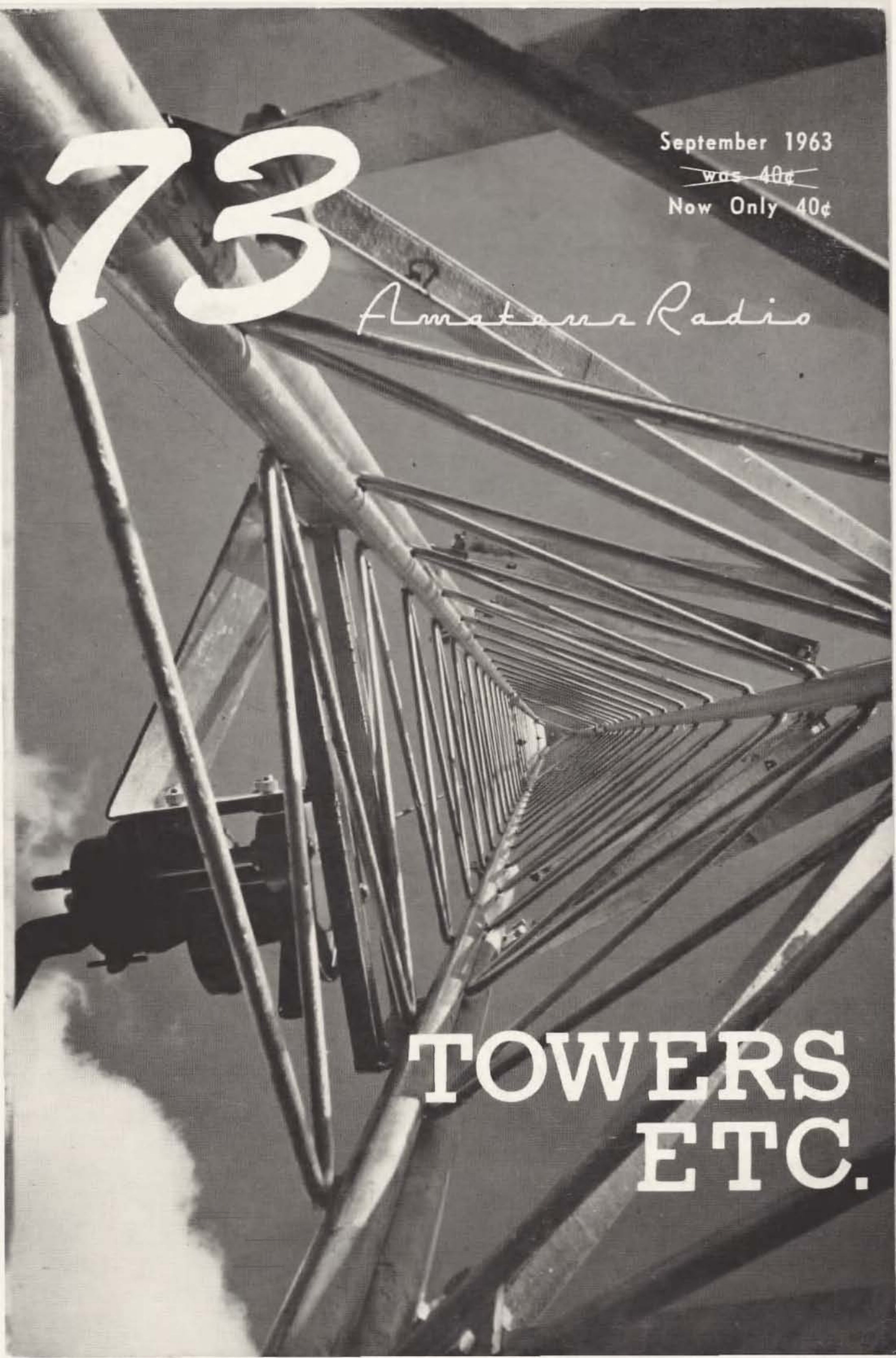
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73 Magazine

Wayne Green W2NSD/1
Editor, etcetera

September, 1963

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Tri-Ex Tower

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de W2NSD

never say die

The way things are popping these days we need a weekly newsletter to keep up instead of a monthly magazine. The biggest bombshell was the publication of part of the "Doyle Diaries" by Evans K6BX in his Newsletter. I'm pretty sure that you won't read one word about this in QST or me-too CQ, which leaves only 73 to spill the beans.

Those of you who are morbidly addicted to my editorials know that I take an awfully dim view of the way K6BX goes about things. He is usually sickenly pompous and emotional in his rantings and often destructive. Well, he hasn't changed. His latest Newsletter emotes and pompouses on for 28 pages; it is a lulu. I enjoyed it.

The important part of the Newsletter, almost hidden amongst the onrush of hysteria, was a word quote of a letter purportedly written by ex-League Director John Doyle W9GPI. I had heard rumors of such letters and how they exposed a plot on the part of a few Directors to take over the ARRL and run it with an iron fist. I had heard that these letters were involved with the sudden resignation of Doyle a few months back. The letter published by K6BX describes in fairly good detail the whole plot . . . the way these men went about reworking the ARRL management system so they could control it . . . their incredible plans for the future . . . and he pulls no punches, naming names and giving intimate secrets about Huntoon . . . Hoover . . . control of QST . . . Budlong being fired . . . how they brow-beat wishy-washy Directors into letting all this happen . . . and on and on.

If the material is a hoax then we should see a healthy legal suit developing. If it is factual, and the details of the letter are hard not be believe since the plans laid out jibe so closely with the events that have happened, then the question arises, "what can be done about the situation and how can it be prevented from happening again?" Since this throws a dark cloud cover over the election of the present Directors one solution might be to turn their chairs over to the Vice-Directors. These gentlemen could then set about eliminating the new Executive Committee system of running things which virtually invites someone to step in and become dictator, with concomitant building funds, cancellations of national conventions, and proposed rules changes being freed down the members' throats.

I suspect that K6BX's News Letter #14 (30¢) may have to go into additional printings.

Incentive Licensing

My mailbag runneth over. A few in favor of restricted voice bands have written in . . . "get all those damned lids off the phone bands" . . . and a couple of thousand opposing it have registered their protest. I've been accused of bias . . . and I admit it. To get the opposite bias you'll just have to read QST.

I do join the proponents of incentive licensing in one thing: decrying the large number of amateurs who,t once they have obtained their license, are content to buy a station and settle back to just plain operating. Few of these chaps read 73 for we have little of interest for them, so there isn't much point in my talking about it here.

But must we turn to government edict to force these lazy amateurs to mend their ways? Must we inconvenience or discourage tens of thousands of amateurs who do take an interest in their hobby? Perhaps there is another way. I know this is heretical in these days of leaping socialism, but my tendency is to try to get along with a minimum of laws and a maximum of understanding and cooperation.

What other incentives are there besides frequency allocations? I'm sure we can come up with something else. Power differentials have been suggested. This, like frequency segregations, would be difficult to police, requiring the FCC monitoring stations to increase their staffs or else forget the whole thing. There are so many multi-kilowatt stations on the air today undetected that it just isn't feasible.

Special call signs have been suggested. I'm inclined to like this idea. Since the old order of call signs has been virtually wrecked we might be able to set up a call sign system which

would reflect license qualifications. Suppose we establish six grades of licenses: Novice, Technician, General, Advanced (same technical exam as Extra, but without 20 wpm code), Extra, and Special (particularly awful exam). The class of license could be designated by the second letter of the call and the status of this special letter would I'll bet, drive a lot of fellows toward higher classes of license. "Double-you Bee Two See Cue Em, this is Double-you (heh, heh) Ess Two En Ess Dee." Well, you know that CQM isn't going to stand that one for long. The extra letter in the call would be a mark of accomplishment and would be much sought after. The lazy amateur would be branded as such every time he goes on the air.

ARRL

If my mail reflects the anti-segregation feelings of the amateurs so strongly, I can just imagine the tenor of the mail flooding in down at Newington. In spite of this mail, the August issue of QST is virtually silent on the subject. One letter in favor, none against, and not one word in the editorial. We don't find out what is really going on until we check into the mice-type in the "Happenings" where we find that the ARRL has submitted two petitions to the FCC, both requesting the assignment of portions of the bands for higher grades of licenses.

There are indications that the pressure of resigning members and irate manufacturers and distributors is being felt. We shall see in the September QST how much they have backed down. It is possible that they may ask that small segment of the phone bands (50 kc) be set aside for higher classes of licenses. This is a good compromise for it is doubtful if the FCC would set themselves up with such a monitoring headache, which would let the whole mess blow over.

The Institute

The shocking exposure of the ARRL by K6BX and the cynical admittance by the League in the July QST editorial that they had no intention of polling the members before making even the most drastic of decisions for them has brought in such a pile of mail demanding that something be done that I have taken a little time off from my mad race to keep everything running here and tried to work out a possible solution to the problem.

The first step in solving a problem is to identify the problem. Perhaps I am over-simplifying things, but it seems to me that

our difficulty is one of communication . . . which is a strange one for a hobby such as ours. But see if I'm not right in this. I suspect that we need a good method of communications for all amateurs to know what is going on and to participate in the formation of new rules r modifications of old ones. If we could find some way to provide a bias-free method of letting amateurs know what each other are thinking I believe that our hobby would run a lot smoother.

Now . . . how do we accomplish such a thing? Well, I have a suggestion.

I propose that we set up an Area Coordinator for each call area who will report on the matters discussed and resolved by clubs within his area. Each Area Coordinator will have Division Directors for each section of his area and these men will attend local club meetings and report on the decisions reached by clubs within their sections. An Area Coordinator might have from five to fifteen Division Directors to keep him up to date on all of his area. The DD will be in touch with the clubs on a direct basis and in touch with club officers so that his reports will reflect the thinking of the amateurs in his section. The Area Coordinator will make a report including the information from the DD's and this report will be published each month by the Institute of Amateur Radio and copies will be distributed to AC's, DD's, all officials of the FCC, ARRL Directors and officers, all government offices in any way involved with amateur radio (MARS, etc.), and by suscription to any amateurs interested in knowing just what is what for the nominal subscription rate of $1 per year, which doesn't cover the costs involved by a long shot, but which will weed out those upon whom it might be wasted.

This whole thing will take a bit of doing, but I think we can get it set up before the end of the year.

This will provide a means for all amateurs who are interested enough in their hobby to attend club meetings or write to their Division Director with their opinions to know what is going on and to wield some influence in the course of amateur affairs. Our little bulletin should be invaluable to the FCC in their honest attempt to manage our hobby in our best interests and should be equally helpful to ARRL Directors, perhaps preventing them from going off on a tangent undesired by the amateurs because of the personal influence of one or two Directors. Since the ARRL is not providing any such service I hope they won't

(Turn to page 88)

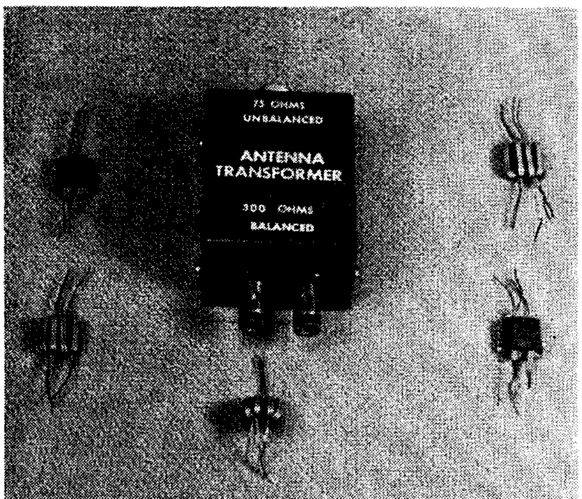
A Cast-Iron Balun

73 Parts Kit

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Photo Credit: Morgan S. Gassman, Jr.

Ferrite components and ferrite core inductors have come into general use in recent years. Despite their appearance in a very wide range of common equipments, many amateurs remain unaware of the amateur equipment applications of these materials and commonly available components. Commercial applications range from the "rod" antennas used in transistor portables to the universally used ferrite core TV horizontal deflection components. One component, which has immediate amateur application, is the broad band matching transformer, or balun, which is widely used in modern TV tuners.



The balun is housed in a Minibox and commercial decals finish off the job. Various views of the unmounted balun are also shown.

Before we go into the applications of the ferrite core unit, a review of the baluns in current amateur use is in order. Baluns (BALanced to UNbalanced rf transformers) are widely used to effect transition from balanced to unbalanced transmission lines with an impedance transformation of 4 to 1. In amateur VHF practice, the most common form of balun is of the coaxial cable type.[1]

In this configuration, a half-wave phasing section of coaxial cable is connected in parallel with the coaxial transmission line. The balanced connection is made across the center conductor terminations of the phasing section which provides the required 180° phase reversal. Since the voltages at the unbalanced end of the circuit are in parallel and the voltages at the balanced end are in series, there is a 4 to 1 impedance step-up from the unbalanced line to the balanced output. While performance of these coaxial line baluns is excellent, there are obstacles. The major problems are the length of line required for the phasing section at the lower frequencies and the limited bandwidth over which a particular balun will operate.

The limited bandwidth problem is overcome in the untuned coil balun. In this configuration, two bifilar wound coils are connected as shown in Fig. 1. At the series connected end, the lines are balanced to ground and will match an impedance of twice the characteristic impedance of the line. At the parallel connected, or unbalanced, end the circuit will be matched by an impedance of half that of the coiled lines. This results in an impedance transformation of 4 to 1. For this circuit to work, the input must be effectively decoupled from the

1. "Coaxial Baluns," WA2INM; December 1962, 73 Magazine

output and this must be accomplished without introducing excesive losses.

In theory, this condition will occur only when the coiled transmission lines are an odd multiple of a quarter wave in length. However, in practice, the coiled lines serve as a choke which effectively decouples the input from the output. Since the inductance of the choke is not critical, these baluns will function over a wide range of frequencies. Bandwidths of 10 to 1 are normal with the lower frequency limit being that at which the windings are less than a quarter wave in length.

The familiar "ladder" coils used in the antenna input circuit of early television receivers were a commercial application of this type balun. Many amateurs have used these coils in their VHF installations with good results. It should be noted that in this discussion only the most common series-parallel balun configuration is treated. This connection results in the 4 to 1 impedance transformation and a transition from balanced to unbalanced lines. Other connections are possible but are beyond the scope of this article. It is in this 75 to 300 ohm, unbalanced to balanced configuration that the TV baluns have been most often used.

With the availability of economical, modern ferrite core materials, their use in TV receiver baluns was a logical development. Since the efficiency of the ferrite core baluns for receiving applications in the range of 54 to 216 mc has been proven in several million TV receivers, it was considered worthwhile to try these units at the lower frequencies. In addition, it was desired to test them in low power transmitting applications. John Landek W9WOK, of Admiral was approached for details on these units and he kindly came through with the information and some samples of the coils used in Admiral TV receivers.

These baluns were used unchanged in the tests that were conducted. The windings of the baluns were connected as is shown in Fig. 1 and the balanced termination connected to a 200 ohm resistive load. The unbalanced termination was connected through a commercial SWR meter to the output of a 3.5 to 60 mc low power transmitter. RG-58/U cable was used between the transmitter, the SWR meter and the balun. The 4 to 1 ratio of SWR meter and the balun. The 4 to 1 ratio of the balun is maintained in this test and use of the 50 ohm line enabled use of the 50 ohm SWR meter and a commercial 50 ohm rf power meter for comparative tests. Subsequent on the air tests verified that similar results are obtained in 75 ohm unbalanced to 300 ohm balanced applications.

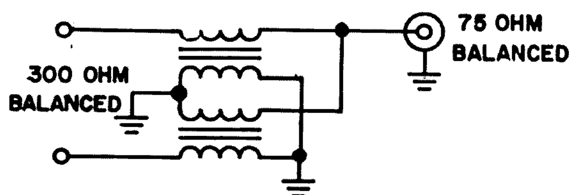
The transmitter was modulated about 90% with a 1000 cycle test tone and the balanced deflection plates of a monitor scope were connected across the 200 ohm load. The purpose of the scope was to observe the modulated rf envelope for flat-topping or other evidence of balun core saturation on modulation peaks. Rf voltage across each half of the 200 ohm load resistor was measured with a Hewlett-Packard 410B VTVM and the actual power in the load computed from these readings. These readings were verified by substituting a commercial rf power meter for the balun and 200 ohm load. The commercial SWR meter was left in the line and switched to the relative power position to insure that the transmitter output remained essentially unchanged under both test conditions. The fingers and the nose were used to gauge heating of the balun core and windings.

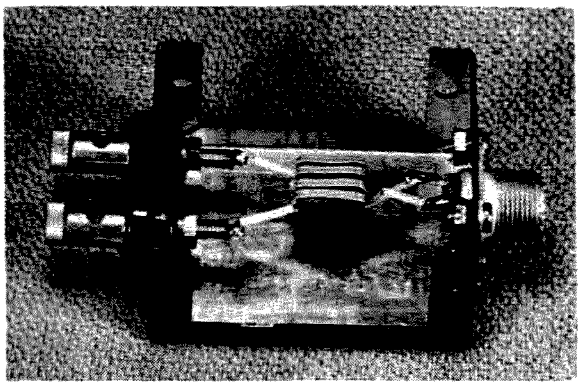
The transmitter was tuned up on 6 meters into the 50 ohm power meter and the loading adjusted for 15 watts output. After the SWR was verified as being essentially 1 to 1, the output was transferred to the balun terminated in the 200 ohm load. Transmitter tuning was touched up for exactly 15 watts output and the SWR was read and recorded. This procedure was repeated on 10, 20 and 40 meters. The balun did not heat excessively at any frequency and no distortion of the modulated rf envelope was noted. Results of these tests were as follows:

Frequency in mc	54	28	14	7
SWR	1.1:1	1.2:1	1.4:1	1.6:1

The transmitter was retuned to 54 mc and the power increased until excessive heating of the balun was observed. The SWR rose slightly at this power level but the rf envelope remained undistorted on modulation peaks. This test was repeated with other baluns of the same type and in each case, excessive heating was noted at between 20 and 25 watts.

Based on these tests, it appears that the unmodified TV baluns will be perfectly satisfactory for use on 6 and 10 meters, could be used on 20 meters and *might* be used on 40 meters. Just to play it safe, a maximum power of 20 watts should not be exceeded. Although the TV baluns were not tested on 2 meters, there is no reason why they should not be fully satisfactory





The ferrite core balun is connected to the coaxial receptacle and the binding post terminals. The balun is supported by its leads.

at these frequencies. As mentioned, the baluns were used unchanged. Somewhat better low frequency performance might be obtained by increasing the number of turns in the windings. However, it is believed that General Ceramics Q-2 ferrite material is used in the cores. General Ceramics recommends this material for use in wide band transformers between 10 and 225 mc so it is doubtful that performance at the lower frequencies could be greatly improved.

Since these baluns are used in most TV sets today, supply should be no problem. Various makes of sets were checked and part numbers obtained. Checks with the local distributors of the various brand sets disclosed that most stock the balun coils. However, since Standard Coil tuners are very widely used and since regular parts distributors stock replacement parts, Standard Coil part numbers are listed. The coil is stocked as an assembly and a few other parts which are not used in this application come mounted on the board. However, the price is still reasonable. Antenna Transformer, Standerd Coil Part Number 31T-413, is the replacement part for the various Model "T" tuners and it sells for $1.90 net. The Antenna Input Assembly for the "FN" and "FD" series of tuners, Standard Coil Part Number 31T3398-01 or -02, sells for $1.15 net.

The photographs show a very convenient method of mounting the ferrite core TV balun. The case is a Bud 2¾" x 2⅛" x 1⅝" Minibox. An SO-239 coaxial connector is mounted on one end of the box with a ground lug secured under one of the mounting nuts. A dual, insulated binding post assembly is mounted on the other end of the box. The balun is wired between the terminals, supported by its leads. Although valuable in the shack, this unit is equally valuable in the shop for various balanced to unbalanced matching jobs.

. . . W4WKM

Noise Limiter for CW

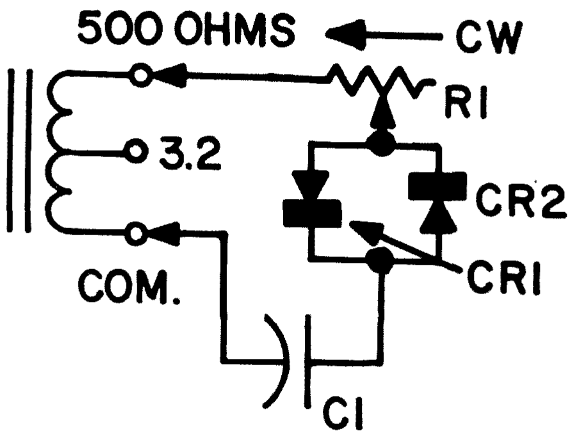
73 Parts Kit

Joe Williams W6SFM

The CW noise limiter shown in the diagram is useful with that type of receiver whose ANL works great on phone but which is next to useless when the set is operated in the CW mode. When connected as indicated, this accessory becomes a form of frequency selective short clamp. In most cases it won't be necessary to remove the receiver from its cabinet in order to make the hook up.

Operation

Since many CW operators prefer a tone of about 500 cycles, all signal and noise energy lying above that frequency within the audio image of the receiver can be trimmed without affecting the legibility of the code. With the diode noise limiter connected and with the receiver gain controls set at normal, the clipping



control, R1, is advanced. When noise pulses of sufficient amplitude appear across the secondary of the output transformer, either or both of the diodes will conduct and a partial short circuit will be applied to the secondary through R1 and CI. CI will, of course, exhibit less ac resistance at the higher audio frequencies and the threshold of avalanche of the diodes will occur earlier at those frequencies. This action takes the sting out of ignition noise, QRN and power line transients. When a noise spike causes the clamp to make, the entire audio product of the receiver is shunted for a few microseconds. The code tones being received will be perforated but unharmed. In severe noise, if the value of R1 is further reduced, the incoming CW signals will trigger the noise limited and the CW will chop holes in the noise with an action like that of a cookie cutter. This sounds a bit strange but often makes otherwise unreadable signals stand out so that they can be copied.

The Connections

Where the receiver has the familiar screw type connectors on the rear apron which are marked 500 ohms, 3.2 ohms and Common—the noise limiter is connected to the 500 ohm post and to Common. If your receiver has only a voice coil connection or has a self contained speaker, the limiter can be connected between the plate of the audio output tube and Ground. If this type of hook up is used, R1 should be 10K ohms and CI should be a .47 mfd at 400 volts.

. . . W6SFM

Parts Kit Available

We've gathered the two diodes, pot and condenser into a package for you. Catalog price is $3.59 on the parts. W6SFM-2 Kit (order from 73, Peterboro, N. H.) $3.00

Errorless RTTY Converter

Jim Kyle K5JKX
1236 N. E. 44th Street
Oklahoma City 11, Okla.

Many RTTY converters, both with transistors and with vacuum tubes, have been described in the past few years. However, only one—the W2JAV unit—has taken full advantage of the 100-percent redundancy inherent in the RTTY code.

That term "redundancy," in case it threw you, is one bandied about by specialists in the field of information theory, and means simply that (in this case) you get two specific items of information at any given instant to tell you what the fellow on the other end sent.

It is inherent in any form of FSK, because if at any one instant a *mark* is being transmitted a *space* cannot be. If you receive both a *mark* and a *space* simultaneously, then something is wrong.

Thus, if our converters were designed so that we had signals available to indicate what was *not* being sent as well as what was, we could reduce errors by requiring both a *mark* and "not-space" to indicate a *mark*, and vice versa.

This, of course, is done in the W2JAV unit—but the converter described here, designed by use of symbolic logic and digital techniques

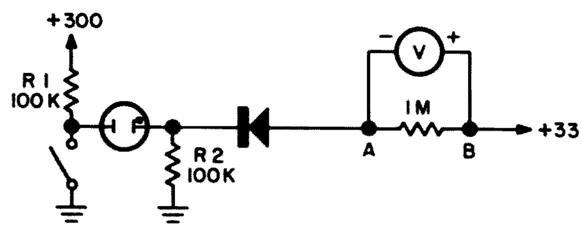


FIGURE 1

Fig. 1. Simplified schematic showing operation of "and" gates, with neon switches. Spst switch at left represents output stage of Schmitt trigger. With switched closed, neon goes out. Diode is forward biased and 33-volt supply flows to ground through 1-meg resistor, diode, and R2 in series. Meter reads approximately 30 volts across 1-meg resistor. With switch open, neon lights and approximately 100 volts appears across R2. Diode is reverse-biased and no current flows from 33-volt supply through 1-meg resistor. Meter reads zero volts. If left half of circuit (all components to left of point A) is duplicated and connected in parallel at point A, **both** switches must be open before current flow through 1-meg resistor is halted.

learned during a two-year bout with the computer industry, offers a few additional advantages.

Among these advantages are the fact that the printer is never allowed to run open, no tuning meter or scope is used yet immediate visual indication of proper tuning is given, and modern filter techniques together with efficient noise-pulse elimination permit copy under the most severe QRM conditions.

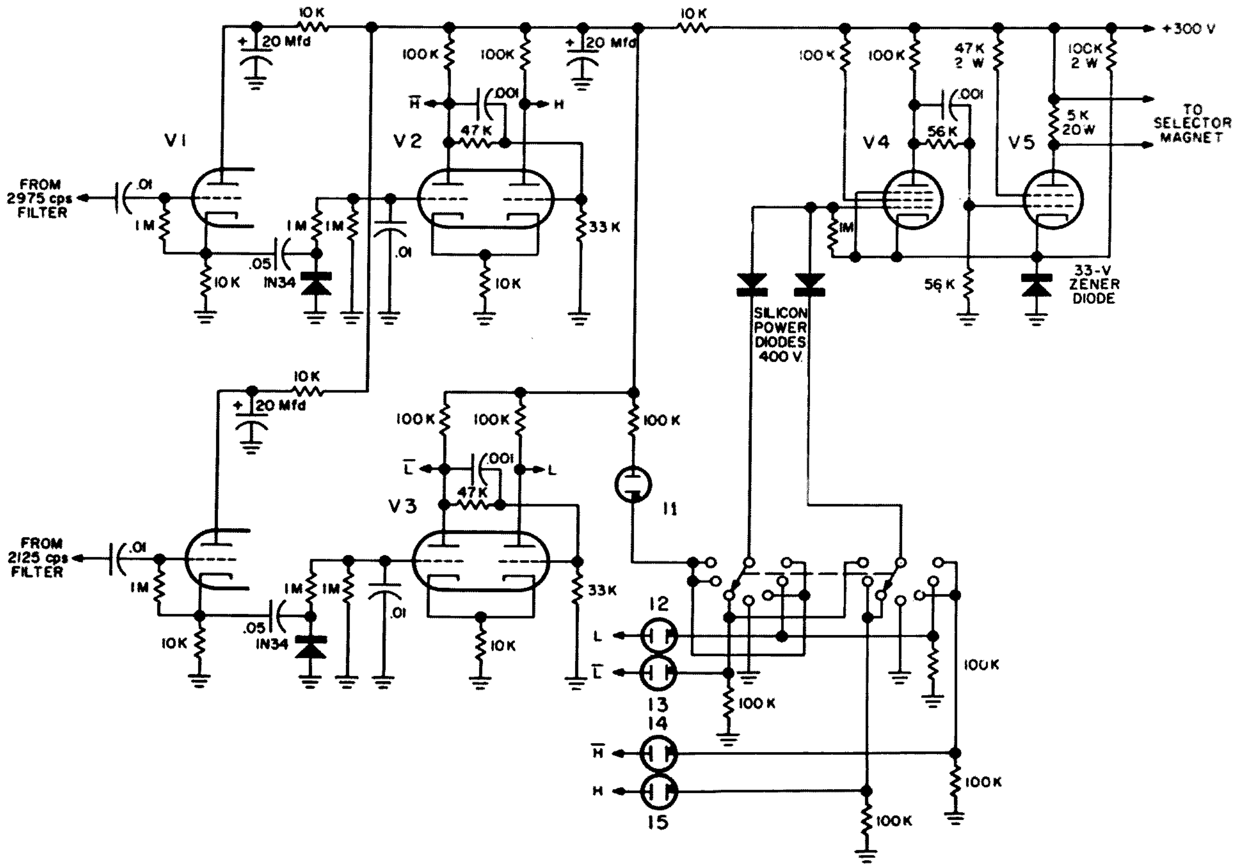
The never-run-open feature is brought about by holding the printer magnet energized at all times *unless* a specifically identified *space* signal is being received. When tuned off channel, tuning through a signal, or receiving only noise, the printer merely sits there.

Tuning indication is by means of a bank of four neon bulbs, which serve a double purpose. Originally included in the design to act as switches in the classic manner, they were brought out to the front panel when it was realized that they offered a valuable aid to tuning and troubleshooting in case of QRM.

Since a seven-position front-panel switch offers the option of "bilateral" (a term invented here to describe the *mark*-plus-not-*space* requirement) copy, *mark*-only copy, or *space*-only copy in both normal and inverted positions, as well as a seventh "no copy" position to insure absolute quiet while tuning under difficult QRM conditions, versatility is about as great as could be hoped for. Though the switch makes things look complicated, it is actually simple to wire in due to the digital circuits employed.

The heart of this converter is the combination of the neon switches and the "and" gate. Fig. 1. is a simplified schematic showing how this works; only one neon and one diode are shown.

The spst switch at the left of the illustration represents the output section of the associated



SCHEMATIC DIAGRAM OF DIGITAL RTTY CONVERTER
FIGURE 2

Switch Positions:

1—Mark only, 2—Space only, 3—Bilateral: Mark low

4—No copy

5—Bilateral, 6—Space only, 7—Mark only: Mark high

V_1, V_2, V_3—12AX7

V_4—6AU6

V_5—6EM5

I_1, I_5—NE2

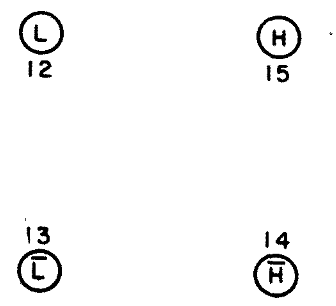


FIGURE 3

VISUAL TUNING INDICATOR PATTERN LAYOUT. SEE TEXT FOR DETAILS.

Schmitt trigger tube and will be either open or closed. Acually, with the values given on the full schematic, about 15 volts will appear at the upper end of the "switch" when it is "closed" but for purposes of explanation it is close enough to a dead short.

With the switch closed, not enough voltage is applied to the neon tube to allow it to fire so it stays dark. Under this condition, the diode is forward biased by the 33-volt supply, and current flows through the 1-megohm resistor, the diode, and R2, all in series. Approximately 30 volts are developed across the 1-megohm resistor by this current flow.

With the switch open, however, current from the 300-volt supply fires the neon tube and it lights. This allows about 100 volts to be developed across R2, which reverse-biases the diode. With the diode cut off, no current can flow through the 1-megohm resistor, and no voltage is developed between points A and B.

If another diode, neon, switch, and two 100K resistors are added to duplicate the left-hand part of the circuit, connecting the added duplicate circuit to point A also, then current can flow through the 1-megohm resistor if either of the spst switches is closed. Only when *both* are open will the voltage from A to B drop to zero; at all other times it will remain at about 30 volts, and point A will be negative with respect to point B.

In the complete converter, point A is connected to the grid of a pentode tube (V4) which forms half of a third Schmitt trigger while point B is connected to the cathode. The tube chosen, a 6AU6, cuts off at considerably less than -30 volts, so that it remains cut off at all times except when both switches are closed.

But at this point, we're a bit ahead of our explanation of the way this gadget works. Let's back up a bit, like all the way back to the receiver.

The complete schematic of the converter, Fig. 2, does not show the input amplifier or the filters. This is because they are not particularly critical. No limiter is necessary, but a band-pass filter from 2 to 3 kc is a definite asset. My own preference is for the 5-section filter described earlier in these pages, fed by a 6J6 operated grounded-grid for simplicity—but even a single-section toroid will surprise you when used with this converter following it, because of the extremely light loading presented by the detectors of Fig. 2.

The first stage shown in the schematic is a dual cathode follower, using half of a 12AX7 in each channel. This is used primarily as an impedance-matching device to prevent the diode detectors from loading the filter outputs.

The IN34 diode detectors are fairly conventional except that they are connected to give positive-going output with signal. The two 1-megohm resistors and the .01 mfd capacitor between the diode and the following-stage grids form a time-delay filter which prevents noise pulses from triggering the following circuitry. Both attack and release time constants are 10 milliseconds; this is long enough to allow positive operation on standard RTTY pulses while rejecting all ordinary forms of noise.

Since the circuits of V2 and V3 are identical, only one will be described. These are Schmitt trigger stages, which have the property that only one of the two triode sections of the tube will conduct at a time. Assuming that the input half of V2 is conducting, its plate voltage as measured at the plate itself drops to about 15 volts. Voltage divider action through the 47K and 33K resistors drops this to only about 6 volts at the grid of the output half. At the same time, about 25 volts develope across the common cathode resistor due to current flow in the input half. The resulting -19 volts from grid to cathode of the output half cut this side off, and plate voltage rises to 300.

When the input half stops conducting, its plate voltage begins to rise. The positive-going pulse at the plate bypasses the 47K resistor through the .001 mfd capacitor and drives the second half into conduction. This increases total current flow through the cathode resistor, increasing cathode voltage and thus helping cut off the input half. When all current flow stops in the input half, the positive voltage developed through its plate resistor, the 47K, and the 33K resistor all in series help maintain conduction in the output half.

Thus you can see that the output half is conducting unless an external signal forces the input half to conduct, and when this happens the output half ceases to conduct. In consequence, we have a high voltage at the plate

of the input half and a low voltage at the output plate in the absence of driving signal, and the reverse when a signal is present. One of the two halves is conducting at all times.

This situation is noted on the schematic by marking the lead from the plate of the output half of V2 "H" for high-frequency-signal-present, and the plate of the input half "not-H" (denoted by a bar over the H on the drawing), for high-frequency-signal absent.

Similarly, the corresponding plates of V3 are marked "L" and "not-L".

The "H", "not-H", "L", and "not-L" signals obtained from V2 and V3 are fed to the neon-switch and "and" gate section whose basic operation was described previously. A brief bout with symbolic logic equations which won't be repeated here showed that it would be necessary to use the "H" and "not-L" signals together to identify a mark-low *space* signal, and the "L" and "not-H" signals similarly for mark-high copy. Under any other possible combination of input signals, we want the printer magnet to hold in the "mark" position.

However, to allow copying from the *mark* or *space* signals only, in case the other side of the signal is jammed by QRM, we must be able to defeat the bilateral feature. This is accomplished by I1 and its associated resistors, which furnish a "fictitious" "H" or "not-L" signal is required.

The seven-position switch selects the proper combination of input signals so that the "and" gate will allow V4 to conduct whenever a "space" signal is being received and at no other times. In the "no-copy" position V4 is permanently cut off.

Both V4 and V5 are part of a power Schmitt trigger which includes the printer magnet itself as its output load. When V4 is cut off, it holds V5 in conduction and the printer magnet is pulled in. When V4 conducts, its plate voltage drops so low that V5 is cut off, and the magnet drops out. The 5K resistor swamps inductive surges from the magnet, while the Zener diode holds cathode voltage fixed at 33 volts postive. A stiff voltage divider might do as well, but the plate current of V5 is something like ten times that of V4 so the Zener is a worthwhile investment.

Magnet current may be set, if desired, by adjusting the value of the screen resistor of V5. I operate my Model 15 at anywhere from 18 to 45 MA without troubles.

Power requirements for this converter are relatively modest, but it should have its own supply. A 100-MA supply will be more than ample. Regulation of the supply is not critical; any small receiver-type transformer should do.

Now to get back to that visual tuning we mentioned once and never came back to. It revolves around the four neon-switch bulbs 12 through 15. If they are arranged in a pattern similar to that shown in Fig. 3, the light pattern itself will indicate proper tuning.

When no signal is coming through either channel, both "not" bulbs (13 and 14) will light and the pattern will be a horizontal bar across the bottom of the square.

In the rare event of QRM in both channels, both "true" bulbs (12 and 15) will light and the bar will move to the top of the square. This is a most improbable pattern to observe.

A steady carrier or tone in either channel will cause the upper bulb in the associated channel to light. For instance, steady carrier in the upper channel would cause 15 to light but would not affect 12 or 13.

Normal frequency of RTTY pulses is about 23 cps; the eye cannot detect pulses faster than about 18 cps. Thus, an incoming RTTY signal properly tuned will make *all* four bulbs appear to be lit simultaneously. The receiver can be tuned for this condition with the converter switch in "no copy," and a flick to either "mark high bilateral" or "mark low bilateral" should result in perfect copy.

Should you be hit by a QRM, a glance at the lights will tell you whether it is in the upper or lower channel; you can then operate the switch to continue copy from the remaining clear channel.

If you want to operate several pieces of equipment from this converter, it's easy to do so. Simply *parallel* all the magnets. Use a 5K resistor at each magnet, to absorb the inductive kicks. That's it—and happy *digital RTTY!*

. . . K5JKX

The Bourbon S-Meter

73 Parts Kit

Richard Van Wickle W6TKA
643 Aurora Avenue
Santa Barbara, Calif.

This article bears its rather strange title because the author is tired of hearing reports from other amateurs who say they are using Scotch S meters.

Seriously, the point of this article is to tell those who have receivers with no S meters how to install S meters. The process is easier than you think. We should also mention that the material presented herein is not new; this article is simply a refresher course in S-metermanship.

S meters perform a number of valuable functions, such as observing changes in signal strength as a beam is rotated, aligning the receiver, and as a basis for lying to another station regarding his signal strength. There are many receivers in use today, either surplus or home built, which do not have S meters. Installation of an S meter in most of these receivers (providing they have an avc and the avc is working) is relatively simple.

The basic S meter bridge circuit is shown in Fig. 1. You can build the gadget in a 5" x 2¼" x 2¼" minibox. There will be four leads going to the receiver from the S meter: ground, filament voltage, plate voltage, and avc. A Jones Type AB male connector can be mounted on the box and a Type AB female connector on the receiver, with a cable between using corresponding connectors. Or, if you want to—and have the room—you can build the unit right into the receiver.

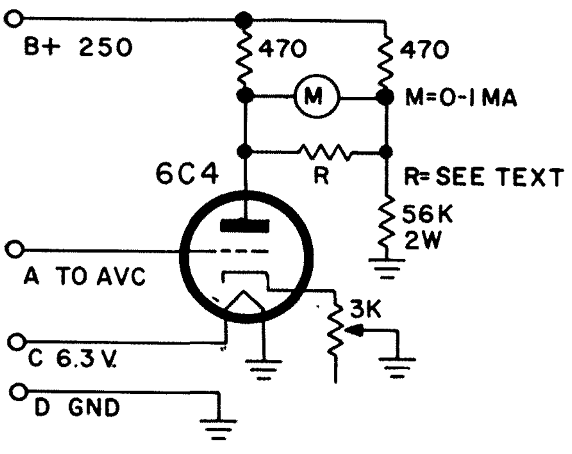


FIG 1 BRIDGE S-METER CIRCUIT

The meter is a 0-1 milliameter, either a Shurite Model 850, or similar inexpensive meter. Several of the amateur radio supply houses stock reasonably priced meters manufactured in Japan which are quite adequate for this purpose.

The thing that scares a lot of hams away from attaching an S meter to their receiver is that they don't know how to identify the avc line. Avc means, of course, automatic volume control. Perhaps a more accurate term would be "automatic gain control," but either way this is how it works: the average rectified dc voltage, developed by the received signal across a resistance in the detector circuit, is used to vary the bias on the rf and *if* amplifier tubes. This voltage is proportional to the average amplitude of the signal so the gain is reduced as the signal strength becomes greater. Thus, the avc tends to keep the receiver output level relatively constant, regardless of input signal. The more stages controlled by the avc, the better the control, and the more constant the gain will remain.

Fig. 2 shows a typical avc circuit. By referring to the schematic for your own receiver (if you don't have one, do your best to get one—they're mighty handy) you should be able to easily locate the avc line. If you have no schematic, you can find the avc line by remembering that the identifying characteristics of the line are that the grid resistors from the controlled stages (usually one or more *if* and rf stages) are all connected to a common line which connects, through a resistor, to a diode—most often one of the diodes in a dual-diode-triode tube.

Now, getting back to our S meter circuit, this is the way it works: the voltage developed by the avc circuit is very nearly a logarithmic function of the incoming signal, so if the S meter tube plate current is proportional to the

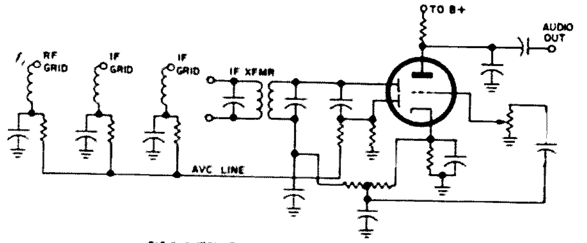


FIG 2 AUTOMATIC VOLUME CONTROL CIRCUIT

grid voltage, the meter will read according to a linear decibel scale. This means that readings won't all be bunched up at one end of the meter scale. This meter, when adjusted as we will describe, will handle a signal range of around 80 db.

Having located the avc line, provided for the necessary four connections, and constructed the S meter, we can now attach, in the receiver, connection A to the avc line, B to B+ (approximately 250 volts), C to the 6.3-volt filament circuit, and D to chassis ground. Don't put the 6C4 in its socket just yet. Turn on the receiver and adjust the resistor across the meter until the meter reads full scale. The value of the resistor, which will probably be in the neighborhood of a few ohms will depend upon the internal resistance of the meter unit.

Then, having arrived at the proper shunt resistance, put the 6C4 in the socket, allow it to warm up, and, with a short length of wire or a clip-lead, short the avc line to ground so that the 6C4 grid will be grounded. Adjust the 3000 ohm potentiometer until the meter reads zero. Now disconnect the avc from ground. The meter will now follow signal variations up to the point at which the voltage is high enough to cut off the 6C4 plate current.

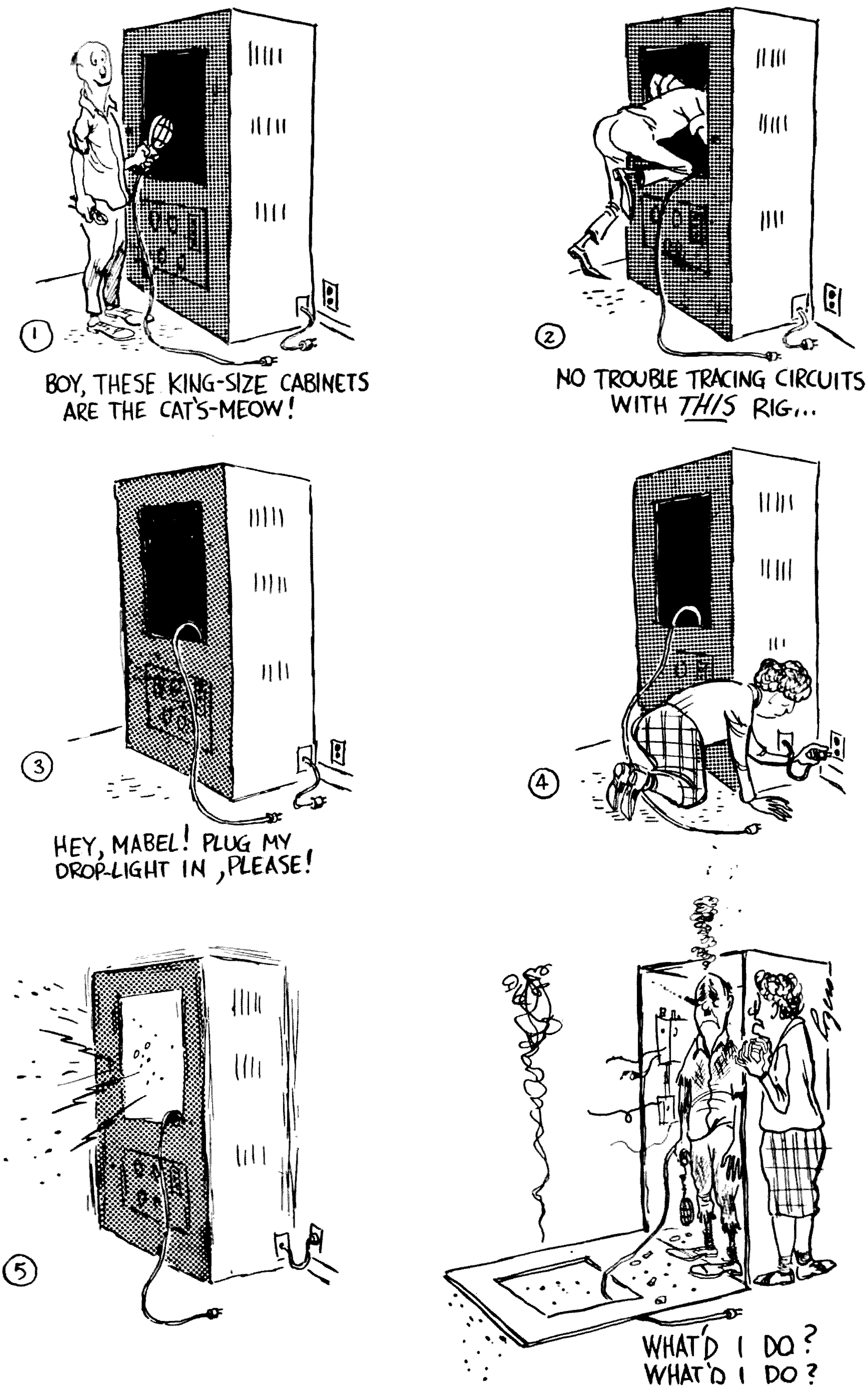
Now to calibrate the meter. Assuming that a full-scale reading on the meter is an 80 db, signal, and that, since S meter units are usually considered to each be equal to six db, S9 will equal 54 db, with each tenth of a milliamp division equalling eight db. S9, then occurs at 0.675 ma, 0.7 is two db over S9, 0.9 is 18 db over S9. (By George, this *is* a stingy S meter!)

If you would like to give higher signal reports and thus make more friends (the degree of friendship increases as the square of the signal report given by the receiving station), at the sacrifice of accuracy, just multiply the figures given above by any factor you desire!

. . . W6TKA

Parts Kit Available

The parts for this doohinky are packaged by 73, Peterboro, N. H. Ask for W6TKA-2 Kit $6.50


1
BOY, THESE KING-SIZE CABINETS ARE THE CAT'S-MEOW!
2
NO TROUBLE TRACING CIRCUITS WITH THIS RIG...
3
HEY, MABEL! PLUG MY DROP-LIGHT IN, PLEASE!
4
5
WHAT'D I DO?
WHAT'D I DO?

Towers

Val Barnes K1APA

Hams press almost anything into service tc hold up their antennas. Chimneys, trees and telephone poles may be used a lot, but there is nothing quite as satisfactory as a good tower. In years gone by a ham had to either build his own out of available materials (latticework or ladders) or else try to find an old windmill or broadcast tower. The advent of fringe area television and burgeoning commercial services have brought many manufacturers into the economy tower making business. You can now buy a complete tower with guys for just about what you would have had to pay for food to biuld your own rickety monstrosity a few years back.

Perhaps you've held back on buying a tower because you are worried about getting it erected. Well, I've proven rather conclusively that you can pick two hams at random with no previous experience and still get just about any ham tower up in the air in a few hours. Using unbelievably incompetent help I've recently erected a 120 foot tower, then used it to remove a 64 element two meter beam from a nearby 100 foot tower. Then I took both towers down and set them up again at the 73 Mountain VHF Station, along with two other 60 foot towers and a new 100 footer. My main helper in most of this is a ham we all call Goat Boy because he spends a great deal of his time butting heads with our pet goat. He's ahead, but his attention seems to wander a lot these days.

Towers. Before buying you'll want to make the decision about whether you are going to buy a crank-up type or a regular un-crank-up type. If you like to make adjustments on beams or change antennas every now and then without risking a nasty fall you should eye the crank-ups.

Though several manufacturers have designed their towers to stand up without guys (some up to 70 feet), it has been my experience that most hams eventually put more on top of the

MANUFACTURER	MODEL	TYPE	MAX. HGT FT	MIN. HGT FT	VERTICAL MEMBERS (INCHES)	WIDTH AT BASE (INCHES)	WEATHER PROOFING	AV. COST $/FT	TOTAL COST	WGT (LBS)
E-Z Way	6046	CU TO	60	26	---	---	HD galv.	5.40	324	---
	HD-40	CU TO	40	24	0.84 OD	8.5	Al. Enamel	2.48	264.00	400
	RBS-40	CU TO	41	25	1.05 OD	10	Al. Enamel	4.14	244.50	350
	RBX-40	CU TO	41	25	1.32 OD	14	Al. Enamel	5.32	350.00	488
	RBS-50	CU TO	51	35	1.05 OD	10	Al. Enamel	4.38	314.50	418
	RBX-60-3	CU TO	60	25	1.32 OD	14	Al. Enamel	5.58	455.00	610
	RBX-70-3	CU TO	73	30	1.32 OD	14	Al. Enamel	6.64	730.00	861
	G10	SS	210	10	1 OD	9.75	HD galv.	2.55	404.20*	430*
	G40	SS	300	10	1.25 OD	16	HD galv.	3.65	517.60*	660*
	HP-34	SSNG	34	34	---	9.75	HD galv.	2.20	84.95	---
Heights	A120	SSNG	120	8	Aluminum	26, 11	none	6.87	894.00	329
KTV	1200-G	SS	130	10	1 OD 14 ga.	12	HD galv.	2.75	537.20*	498*
	1600	SS	130	10	1 OD 14 ga.	16	HD galv.	3.25	593.23*	454*
	1600-XX	SS	130	10	1 OD 14 ga.	16	HD galv.	4.00	673.20*	606*
Masley	100	CU HB	105	21.5	---	17.6	Epoxy Resin	---	510.51	395
	300	CU HB	88	21	---	20.6	Epoxy Resin	3.54	440.11	390
	400	CU HB	37	20.3	---	14.75	Epoxy Resin	3.92	208.66	165
	500	CU HB	88	21.7	---	26.6	Epoxy Resin	5.42	698.80	620
	600	SS NG	50	50	1.66 OD x .128	28	Epoxy Resin	6.50	324.95	445
	650	CU TO HB	54	21	---	---	Epoxy Resin	6.86	515.90	935
	700	CU TO HB	71	21.5	---	---	Epoxy Resin	11.45	1009.90	1745
	750	CU TO HB	71	21.5	---	---	Epoxy Resin	14.00	1189.90	1785
Rohn	6	CU	71	20	1 OD 14 ga.	14.5	HD galv.	3.98	395.60	370
	25	TO	48	21.5	1.25 OD 16 ga.	12.5	HD galv.	5.63	207.10	350
	25	SS	280	10	1.25 OD 16 ga.	12.5	HD galv.	2.61	402.95*	513*
	45	SS	350	10	1.25 OD	16.75	HD galv.	4.89	706.90*	884*
Supreme	40-1	CU	40	23	1.12 OD 17 ga.	8.75	Al. Paint	2.97	129.00	132
	40-2	CU	40	23	1.12 OD 17 ga.	8.75	Al. Paint	3.72	159.00	140
	40-3	CU	40	23	1.12 OD 17 ga.	8.75	Al. Paint	5.97	253.50	170
	60-4	CU	60	24	1.12 OD 17 ga.	11.25	Al. Paint	6.57	414.50	350
	60-5	CU	60	24	1.12 OD 17 ga.	26.5	Al. Paint	11.56	695.00	425
Tristao	100	CU HB	105	21.5	---	17.6	Epoxy Resin	3.32	476.31	395
	300	CU HB	105	21.75	---	23.5	Epoxy Resin	3.89	593.17	520
	400	CU HB	105	22	---	26.6	Epoxy Resin	5.72	817.40	790
	500	CU HB	105	22.5	---	30.5	Epoxy Resin	7.46	1073.65	890
Tri-Ex	HM-354	CU TO HB	54	20	1.5 OD x 0.12	23	HD galv.	9.43	509.00	850
	SX-6105	CU HB	105	21.8	1.25 OD x .083	27.6	Epoxy Resin	9.87	1124.83	1030
	HM-237	CU TO HB	37	20	1.50OD x 0.12	23	HD galv.	7.40	359.95	385
	HS-6105	CU HB	105	20	1.250OD x .083	24.75	Epoxy Resin	8.07	951.27	870
	H-471	CU HB	71	20	1.25 OD x .083	19.37	Epoxy Resin	4.41	387.24	365
	T-588	CU HB	88	21	1 OD x .065	13.87	HD galv.	2.53	426.55	280
	10	SS	120	10	1 OD x .065	14	Epoxy Resin	2.51	612.57	485
	EMPIRE	CU HB	46	20	16 ga.	---	HD galv.	2.42	205.01	176
Vesto	VHP	SS NG	100	22	2.5 x 2.5 L	---	HD galv.	13.12	1312.00	3000
WRL	SPIRE JR	SS NG	8	8	U Channel	34	galv.	2.12	16.95	---
	SPIRE	SS NG	32	32	U Channel	19.75	galv.	1.56	49.95	115
	SPIRE	SS NG	40	40	U Channel	22.3	galv.	1.81	72.25	160
	SPIRE	SS NG	48	48	U Channel	25	galv.	2.20	105.50	230

CU TO = crank-up, tilt over
SS = self-supporting
SS NG = self-supporting, no guys
CU HB = crank-up, hinged base
CU = crank-up
HD galv. = hot-dipped galvanized
AVERAGE COST = exclusive of guys, base, etc.
*Computed for 100 foot tower.

tower than the manufacturer had in mind when he calculated wind loads and it is well worth the added expense and bother to put in some guys. You can guy the tower to trees, houses or even screw anchors which all the tower companies have available. With a little extra effort you can use the guys as an inverted V antenna for the lower frequencies.

The minimum height of a tower is either the cranked-down height or else the length of one section of a regular tower. The size and gauge of the vertical legs gives you a good indication of the strength of the tower. The leg-to-leg distance is the width at the base. Crank-up towers naturally are smaller at the top since each section slides down inside the one below it.

If you have a rigorous climate you may pay more than passing attention to the finish. The hot-dipped galvanized is a bit more durable and thus is more expensive.

The cost-per-foot does not include guys and other accessories and is thus merely a relative figure. The total cost of the tower does include everything.

Many manufacturers can supply special top

sections to fit just about any commercial rotor. KTV has an arrangement for cranking your rotor and beams up and down the side of the tower called Hy-Track.

When you consider that raising your beam even thirty feet can make a world of difference it is worth while to take a close look at this chart. About the only tool you'll need that is special is a "gin" pole and this can be bought or borrowed from most tower companies. If you are going to do any great amount of high work you might do well to invest $17 in a lineman's belt or else hound the surplus houses until you find one at a bargain.

We have one tilt-over crank-up tower and it is a great comfort, though I must admit to a slight wince at the initial cost. This is mighty handy for us when we get in a new antenna to test out. It only takes a few minutes to go out and crank it down, then over so we can remove the old antenna and install a new one. Inside of a half hour it is back up ready to use.

While most tower manufacturers are extremely helpful and have interesting and educational literature, you may have as much trouble as we did with a couple. Good luck.

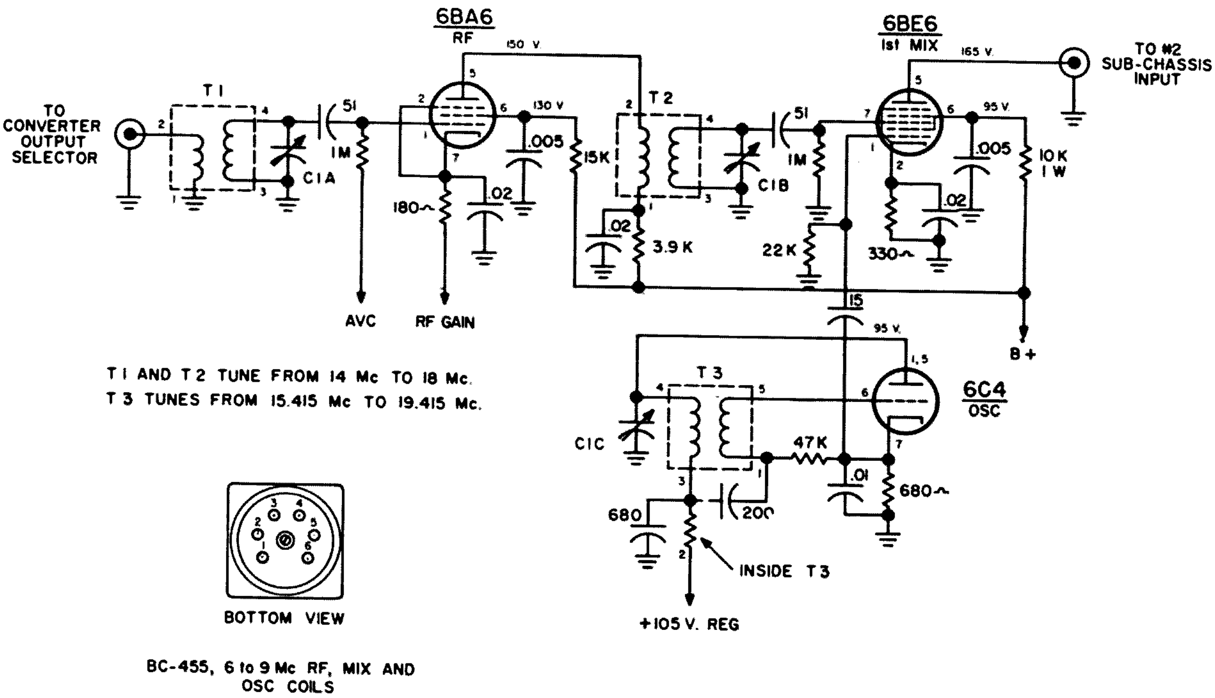
Institute of Amateur Radio

Membership in the Institute is growing rapidly. Yearly membership costs only $1.00. Purpose: to make ham radio more fun. Programs: Group trip to Europe in October. Protection of minority groups (such as ham-TV'ers who are trying to open frequencies on two and six for experimental purposes; ARRL opposed(. Protection of minority groups (such as General and Conditional Class licensees who have suddenly found that they need protection). Establishment of communications between all amateurs, the FCC, the ARRL, government agencies, etc. We desperately need your help, won't you join? Send your name, call and address with $1 to Institute of Amateur Radio, Peterborough, N. H.

Louis Hutton WØRQF
2608 S. Fern
Wichita 17, Kansas

A VHF Receiver

For some time I had been using the ten meter band on my receiver as a tunable *if* for a six meter and two meter converter. This mode of operation tied up the ten meter band and limited my coverage on the VHF bands. The idea began to dawn that what I needed was a separate VHF receiver capable of covering the full four megacycles of the six and two meter bands. The receiver described in this article consists of a tunable *if* covering a four megacycle range from 14 mc to 18 mc. Detectors are provided for AM, CW and SSB. Controls include audio and rf gain, noise limiter, SSB/CW-AM mode, avc, and selection of either a six or two meter converter or tunable *if* input. The approximate cost of the receiver including the two VHF converters and all new components will be less than $200. A minimum of



#1 SUB-CHASSIS VHF RECEIVER
14 Mc-18 Mc TO 1415 Kc IF

tube types were used in order to keep tube inventory reasonable. Some of these new receivers use a different type tube for each stage of the set. Although the junk box collection for this project was started over a year ago the construction took about a month and a half of evenings and weekends. Assembly of the two commercial VHF converters required about six evenings of time.

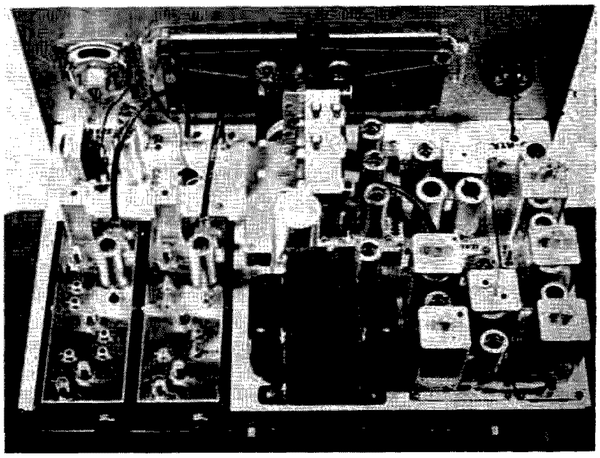
Circuit Description

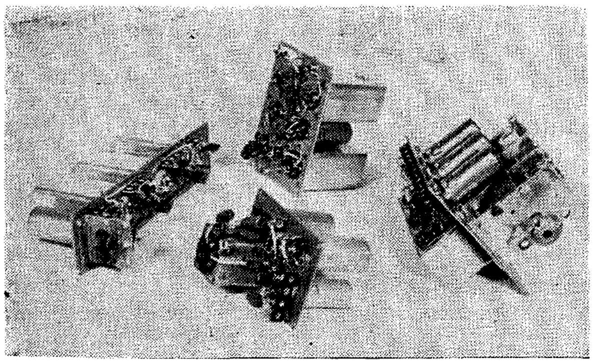
The receiver circuitry begins with an AMECO six or two meter Nuvistor equipped converter whose output covers the 14 mc to 18 mc band. A selector switch controls the B+ to each converter and the appropriate rf output to the input of the receiver. The receiver consists of four sub-chassis. The first is a tunable front end covering 14 mc to 18 mc whose output is 1415 kc. The second sub-chassis amplifies the 1415 kc signal through one stage of *if* and converts it to 239 kc. The third sub-chassis consists of two stages of low frequency *if* amplification and an AM detector, avc detector, and the ANL stage. The fourth sub-chassis includes the SSB/CW detector, bfo and the tuning meter detector. The power supply and audio stages are located on the main chassis.

Construction

Two surplus ARC-5 command type receivers were acquired for junking purposes. These two units covered the range from 3 mc to 6 mc, and 6 mc to 9 mc. The tuning condenser and the associated coils were removed from the 6 mc to 9 mc unit for use in the first sub-chassis. The gear mechanism was removed from the tuning condenser. All the rotor plates but two were pulled from the rf and mixer sections of the tuning condenser. Three rotor plates were left on the oscillator section. The rotor plates with all the slots that are used for tracking purposes

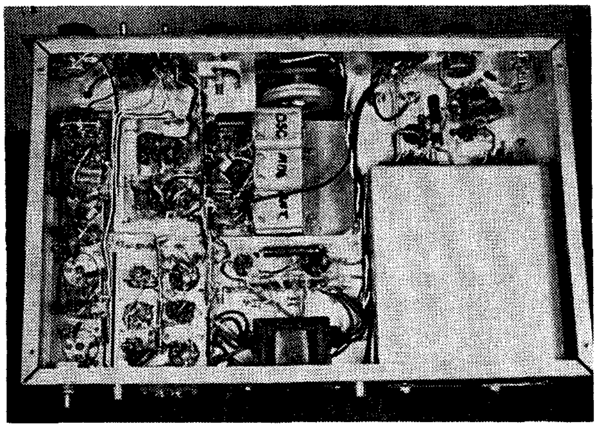
(Turn to page 30)



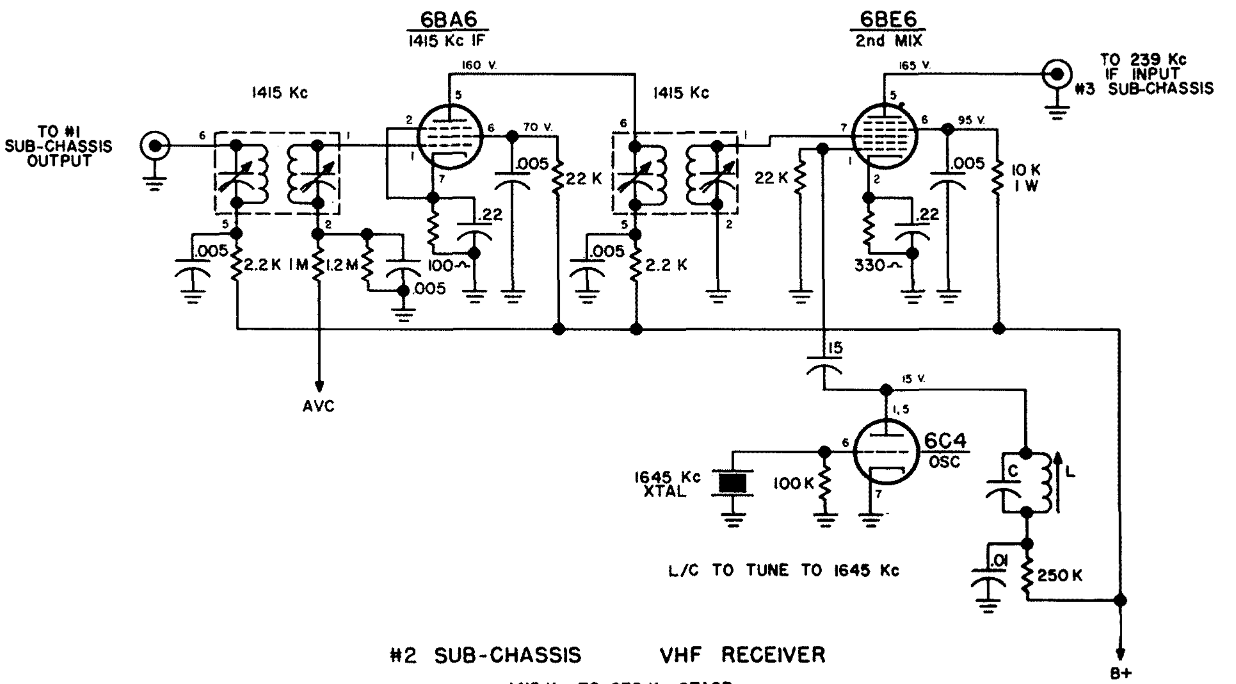


were left on the rotor also. The oscillator, mixer and rf grid coils were modified by removing half the turns plus one. The original *rf* coil was connected to the antenna through a coupling condenser. This coil is further modified by adding a new antenna winding over the cold end of the coil for antenna and ground connections. This coil is made from some of the wire removed during the above changes. It consists of about five turns. The tuning condenser comes equipped with trimmer condensers for the oscillator and mixer sections but none for the rf section. An Erie 7-45 mmf trimmer was soldered across the rf tuning section of the three gang condenser. One end was soldered to the stator and the other end soldered to the frame of the tuning condenser. This will provide trimming adjustments for all three stages of the front end to aid in tracking.

The modified coils were then replaced in their shield cans and each one breadboard connected to the three gang condenser to check for proper frequency coverage. The rf coil and mixer coil were checked for proper frequency coverage using a Grid Dipper. The oscillator circuit was tacked together and the frequency coverage checked with a Frequency Meter. The oscillator must cover from 15.415 mc to 19.415 mc, if a 1415 kc *if* is to be used. The rf and mixer coils must cover the 14 mc to 18 mc of course. The powered iron slugs found inside the coil forms were backed off until they were almost to the end of their travel. The trimmer condensers on the three gang tuning condenser are used to set the high frequency end of the dial, and the slugs are used to set the low frequency end of the dial. As would be expected in any coil tracking job there is interaction between adjustments.

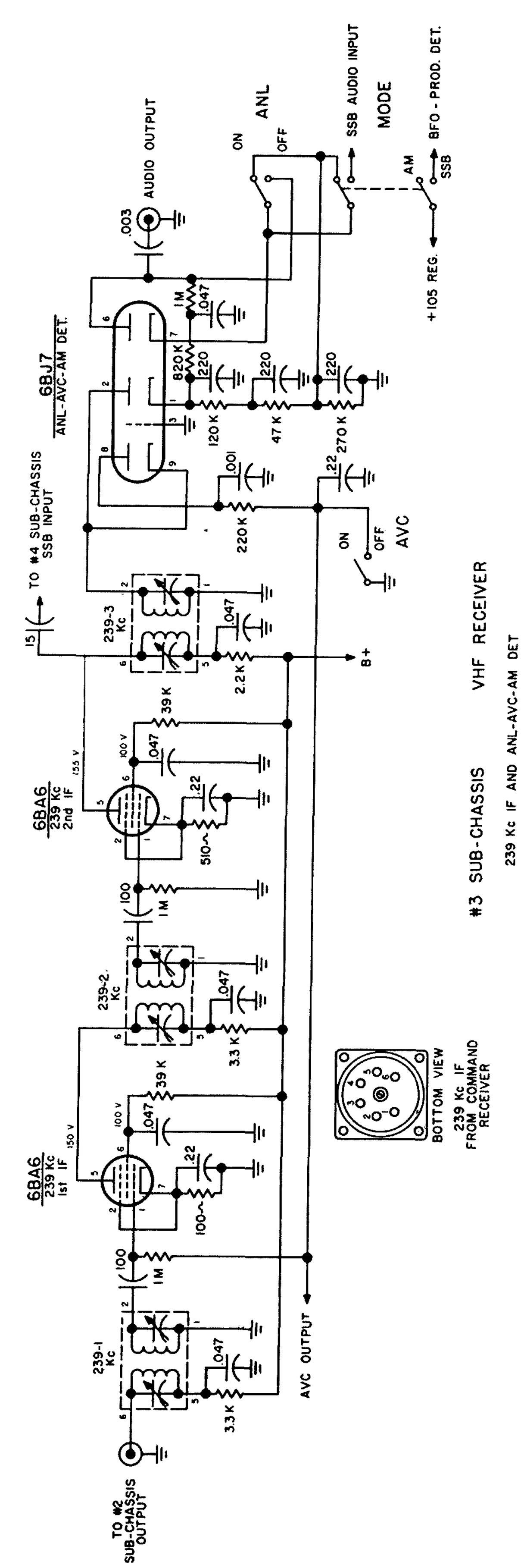


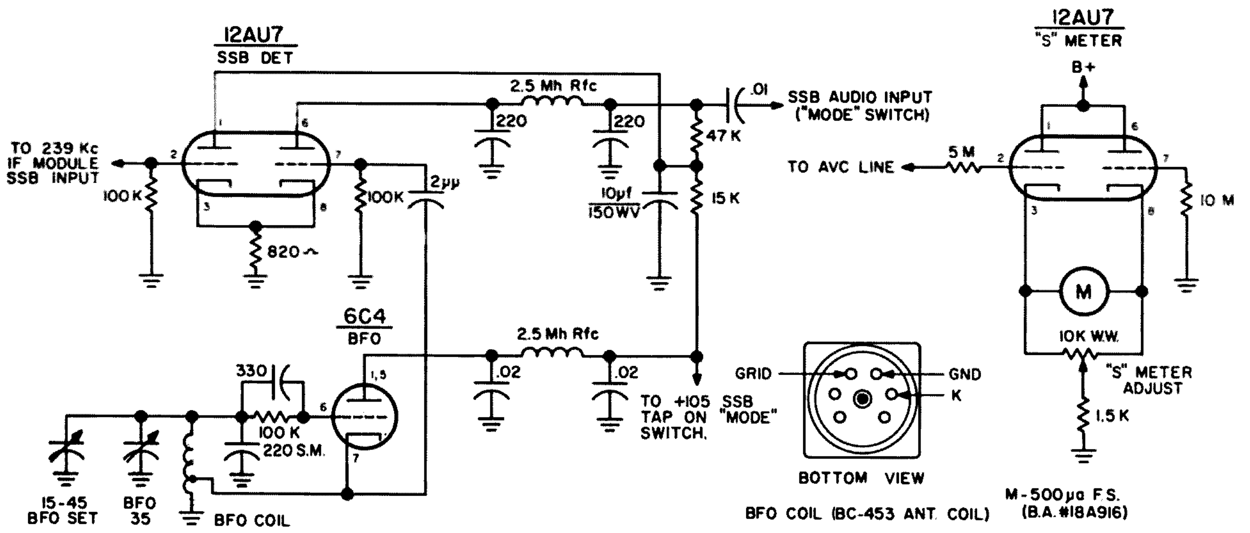
The 1645 kc oscillator coil on the second sub-chassis was constructed from a salvaged slug tuned coil form and mounted in one of the scrapped Command Receiver *if* cans. Its resonant frequency was determined by a Grid Dipper. After I was fairly well along with this sub-chassis one of my ham visitors quietly men-



#2 SUB-CHASSIS VHF RECEIVER

1415 Kc TO 239 Kc STAGE


#3 SUB-CHASSIS VHF RECEIVER
239 Kc IF AND ANL-AVC-AM DET
6BJ7
ANL-AVC-AM DET.
6BA6
239 Kc
2nd IF
6BA6
239 Kc
1st IF
239-1 Kc
239-2 Kc
239-3 Kc
AUDIO OUTPUT
ANL
ON
OFF
SSB AUDIO INPUT
MODE
AM
SSB
BFO - PROD. DET.
+105 REG.
AVC
AVC OUTPUT
B+
TO #4 SUB-CHASSIS SSB INPUT
TO #2 SUB-CHASSIS OUTPUT
BOTTOM VIEW
239 Kc IF
FROM COMMAND
RECEIVER

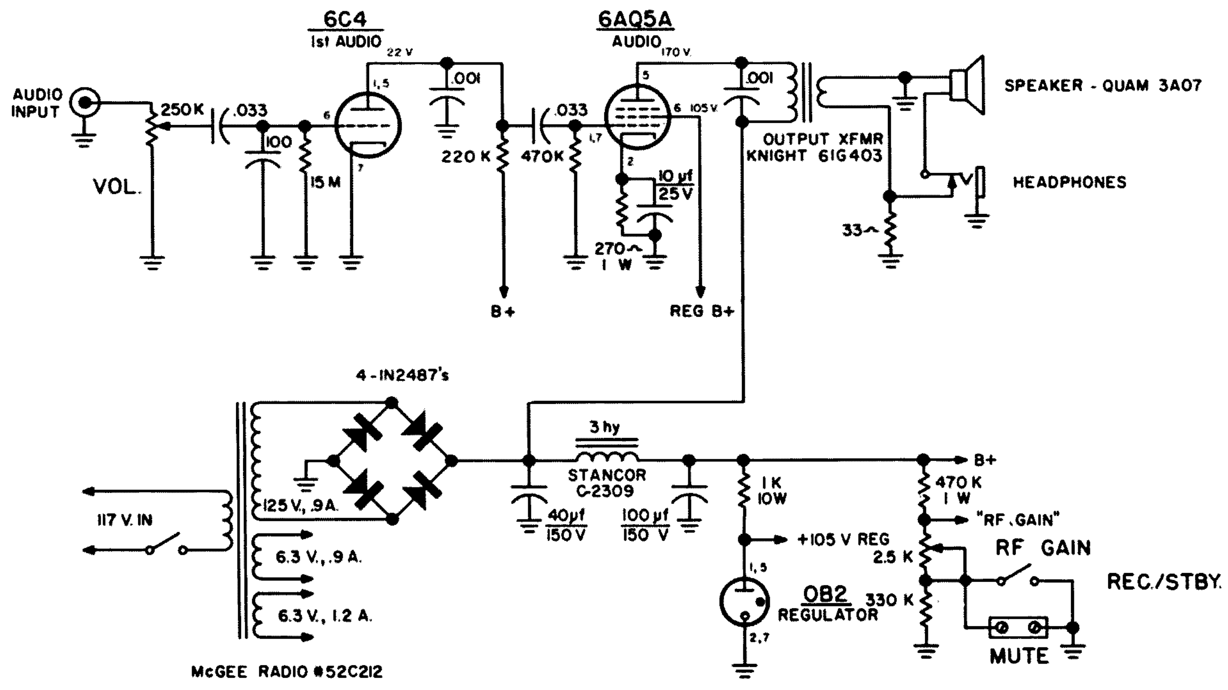


#4 SUB-CHASSIS VHF RECEIVER

PRODUCT DETECTOR-BFO-"S" METER

tioned that there was a broadcast station on 1410 kc in the vicinity. This resulted in some head scratching and scheming to keep wire lengths short for minimum spurious pickup and I was most happy to find no birdies from that station in the final product. When the third sub-chassis was finished wiring I hooked it up to a power supply and signal generator for *if* alignment. After this stage was aligned the second sub-chassis was temporarily connected to the third sub-chassis and given a checkout and preliminary 1415 kc alignment.

The bfo and product detector section gave me the most trouble. The original circuit used a 6BE6 product detector but I could not get it to function as I thought it should. The sub-chassis was removed from the main chassis and modified to use the old reliable 12AU7 double triode product detector circuit. The bfo coil was made from the rf coil removed from a BC-453 Command Receiver that had been salvaged in previous construction projects. The



#5 MAIN FRAME VHF RECEIVER

AUDIO-POWER SUPPLY

biggest problem using this coil was that I could not tell for sure at what frequency it was oscillating. Harmonics from the oscillator leaked into the 1415 kc *if* stage making it difficult to set the injection level on the product detector. A careful check of the frequency by a Frequency Meter indicated that it was too high. Additional padder condenser brought it down to the proper frequency of 239 kc. This cleared up the last of the troubles with the receiver.

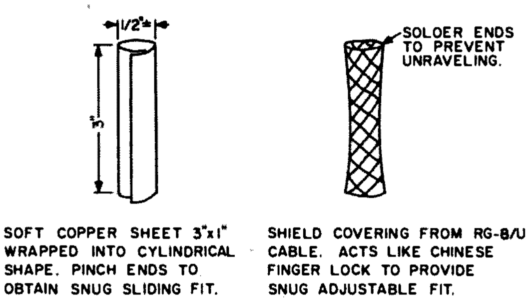
The cabinet is a LMB model W1D using a 11" x 17" x 3" chassis. The front panel was painted and striped in the same manner as my 500 watt linear amplifier that was described in a recent issue of 73 Magazine. The chrome trim on the front panel came from the dash of a junked car. The dial is one of those fine Eddystone units made in England. I added internal lighting by installing a pilot light at each end of the dial assembly. The pointer on the dial and the tuning meter are painted a bright red. The cabinet is a light grey, the front panel is dull black and dark grey. The dial is calibrated from 14 mc to 18 mc using the frequency meter. The remainder of the dial scales are geared to this calibration. Typical 432 mc and 1296 mc converters suitable for use with this receiver may be found in the 1963 *Radio Amateur's Handbook.*

. . . WØRQF

"Receiver? Now what would **she** do with a receiver?"

Heliwhip Tuning without Pruning

Frank Mohler W2IAZ
187 Broad Street
Eatontown, New Jersey



TYPES OF TUNING CYLINDERS
FIGURE I

After using heliwhips for mobile operation during the past few months. I was able to arrive at a few conclusions you may find interesting. In the first place, the heliwhip is an efficient, high-Q antenna and offers the unique appearance. However, like base-loaded and advantages of short length and unobtrusive center-loaded whip antennas, the heliwhip is frequency conscious and restricts QSY operations to a narrow portion within a band.

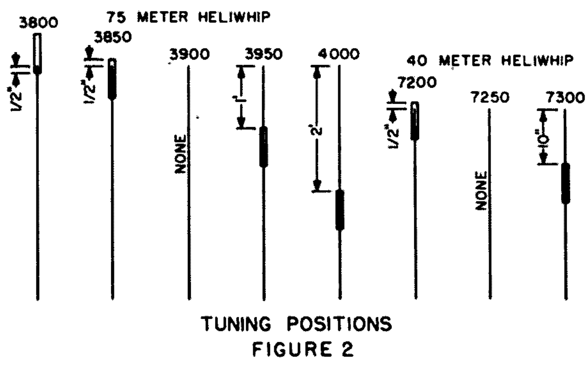
After a series of tests and measurements, I learned that a given heliwhip has a bandwidth that is approximately equal to 1 percent of the antenna's optimum frequency. For example, a heliwhip peaked to 3900 kc has a bandwidth of about 39 kc (.01 x 3900). Satisfactory operation with this heliwhip is therefore limited to the range of frequencies 3880 kc to 3920 kc, or roughly 20 kc either side of the optimum frequency.

The same bandwidth percentage (1%) is applicable to the other bands. For 40-meter operation, a heliwhip pruned to 7250 kc will be useful over the band 7215 kc to 7285 kc. A 20-meter heliwhip cut for 14,250 kc is good over the range 14,180 kc to 14,320 kc. When peaked to 21,300 kc, a 15 meter heliwhip permits satisfactory operation over a range of frequencies 100 kc on either side of the resonant point.

A review of the bandwidth capabilities of each antenna reveals that a heliwhip cut for optimum operation in the middle of the band will provide adequate coverage on all bands except 40 and 75 meters. Unlike the base-loaded and center-loaded whip antennas, the heliwhip has no provisions for altering the operating frequency. After the wires of the heliwhip had been irrevocably cut, or pruned, to a desired frequency, operators accepted the sad fact that QSY operations were severely limited. However, owners of heliwhips need not be shackled to a narrow band of operation. By using the simple tuning technique described in the next paragraph, the operator can peak-tune his heliwhip antenna to any part of the band, including the cw portion at the low end and the MARS frequencies outside the high end.

Heliwhip Tuning System

Heliwhips, as you know, are made by spirally winding the wire on a fibreglass core. Because of this unique construction, heliwhips can be peak-tuned to different parts of the band in less time than it takes to tune a guitar string. All you need is a 3-inch cylinder of copper or aluminum that will fit snugly over the helical windings of the antenna. By sliding this metal cylinder up or down on the heliwhip, the resonant frequency of the antenna is lowered or raised. Fig. 1 shows two types of tuning cylinders you can make. In an emergency, alu-



TUNING POSITIONS
FIGURE 2

minum foil from a pack of cigarettes can be used.

The table in Fig. 2 shows the position of the tuning cylinder for each 50 kc change in the range 3800 to 4000 kc. Similar settings for the 40-meter heliwhip are also given. Present calibration marks on the heliwhip permit rapid positioning of the tuning cylinder when optimum operation on a different part of the band is desired.

Operating Notes

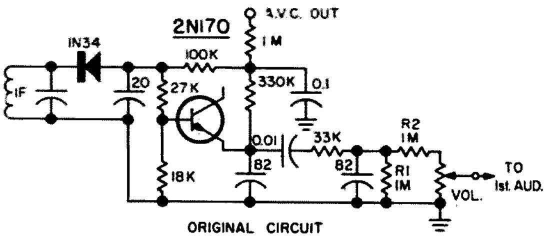
Newly purchased heliwhips are designed by the manufacturer to resonate at the low-frequency end of the phone band. An unpruned 75-meter heliwhip will, therefore, operate best on 3800 kc. To facilitate QSY operations within a band, I peak-tuned each antenna to the middle of the band. In this way, the amount of deviation required to tune up on either band edge is kept to a minimum.

Heliwhips provide high-Q, above-average radiation efficiency when the antenna is peak-tuned to the desired frequency. However, QSY operations are handicapped by the lack of provision for tuning the antenna to different frequencies. To overcome this advantage, while enjoying the efficiency of these unobtrusive antennas, try the "tuning without pruning" sliding cylinder. Man, it's the most!

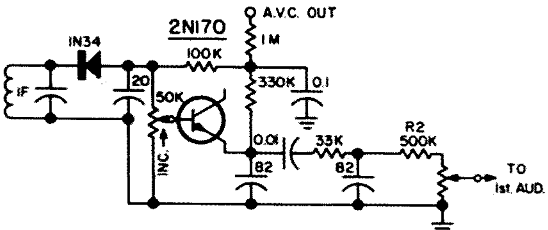
. . . W2IAZ

Rate of Change Limiter cont.

Shortly after receiving the September 73, I got busy and built the rate-of-change limiter by K5JKX. There were some rather obvious improvements to be made, especially to the load impedance, which I felt you might want to pass along to your readers.



ORIGINAL CIRCUIT
FIGURE



MODIFIED CIRCUIT
FIGURE 2

Refer to Fig. 1. The load on the limiter consists of R_1 in parallel with the series resistance made up of R_2 and the volume control. For a 500K control, this load would be 600K, not 1 megohm. If 3 volts audio appeared at the limiter output, only 1 volt would appear on the 1st audio grid with the volume control wide open; a loss of about 9 db.

As shown in Fig. 2, the fixed load resistor, R1, is omitted. R2 is chosen to give a total resistance of 1 megohm when placed in series with the volume control. In this case, the limiter sees a load of 1 megohm, and 1.5 volts of the 3 volt audio would be impressed on the 1st audio grid; a loss of only 6 db. (The 6 db figure quoted by Kyle must have been for a 1meg control, in which case neither R_1 nor R_2 yould have been required.)

A further refinement is the use of a 50K potentiometer in place of the 27K and 18K resistors. This allows the effective bias to be set for optimum noise suppression.

Since adding this unit to my Lafayette HE-30 receiver, I can operate with my 8 foot strip flourescent on!

. . . K5HPT

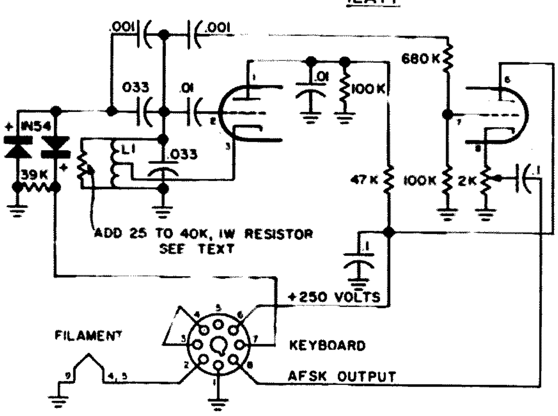
AFSK Oscillator

After completing the Twin City TU AFSK oscillator, the main drawback was that the space tone (2975 cycles) was 50 percent lower in level than the mark tone (2125 cycles). All kinds of equalizing configurations were tried to no avail. Finally a 30K-ohm 1 watt resistor was shunted across the toroid coil LI, to equalize the Q when the IN54's were switched to mark and space tones. Sure enough this method resulted in a considerable improvement between the level of the two tones.

The correct value of resistor depends on how active the circuit is oscillating. Choose a value between 25 and 40K-ohms that will allow the least resistance to be shunted across LI and still not cause the oscillator to be sluggish by oscillating intermittently.

Now the reports on VHF AFSK are amazing with only a 1 db difference or less between the mark and space tones resulting in a marked improvement with stations reporting solid copy —plus the ability to work more DX. The same approach works equally well with other AFSK circuits.

. . . K4GRY



AFSK OSCILLATOR FOR THE TWIN CITY TU

Propagation Charts

For DX work we will usually find that when working on the proper frequency the best signals are to be found during that portion of the day when the sun is shining on both ends of the circuit. The poorest signals are found just before the sun sets, or rises, on the Western terminal of the circuit. This is the frequency transition period.

During summer, when twilight is prolonged, the effect is least but during the winter months when the twilight period is short the effect can be quite severe.

As we pass through September this effect will become increasingly manifest.

During even quite severe disturbances DX signals can be good during the daylight hours but go bad near the sunset hour often not to return until daylight the next day.

J. H. Nelson

EASTERN UNITED STATES TO:

GMT–	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	40	40	40	40	40	40	40	20	20	20	20
ARGENTINA	15	20	40	40	40	40	20	15	15	15	15*	15*
AUSTRALIA	15	20	40	40	40	40	40	40	40	40	20	15
CANAL ZONE	20	40	40	40	40	40	20	20	20	15	15	15
ENGLAND	40	40	40	40	40	20	20	20	20	20	20	20
HAWAII	15	20	40	40	40	40	40	40	20	20	20	20
INDIA	40	40	40	40	40	40	20	20	20	20	20	40
JAPAN	20	40	40	40	40	40	40	40	40	40	40	20
MEXICO	20	20	40	40	40	40	40	20	20	20	15	15
PHILIPPINES	20	20	40	40	40	40	40	40	40	40	40	20
PUERTO RICO	20	40	40	40	40	40	20	20	20	20	15	15
SOUTH AFRICA	20	40	40	40	40	20	20	20	15	15	15	20
U.S.S.R.	40	40	40	40	40	40	20	20	20	20	20	40

CENTRAL UNITED STATES TO:

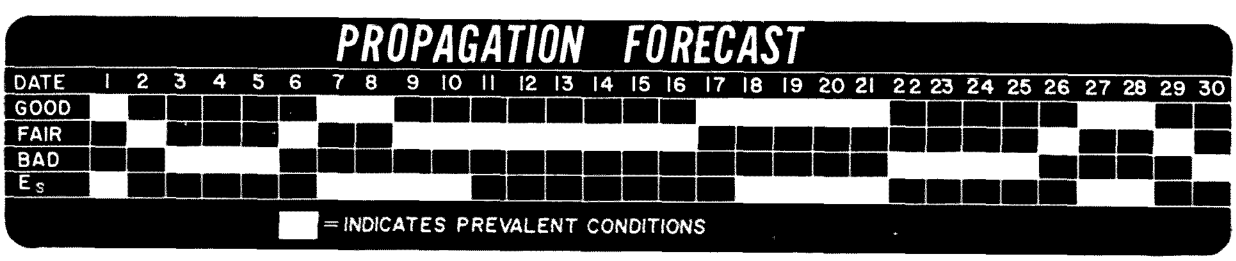
GMT–	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	40	40	40	40	40	40	40	20	20	20
ARGENTINA	15	20	20	40	40	40	20	15	15	15	15*	15*
AUSTRALIA	15	15	20	40	40	40	40	40	40	40	20	15
CANAL ZONE	15	20	40	40	40	40	20	15	15	15	15	15*
ENGLAND	40	40	40	40	40	40	20	20	20	20	20	20
HAWAII	15	15	20	40	40	40	40	40	20	20	20	15
INDIA	40	40	40	40	40	40	40	20	20	20	20	20
JAPAN	20	20	40	40	40	40	40	40	40	40	20	20
MEXICO	20	20	40	40	40	40	40	20	20	20	20	20
PHILIPPINES	20	20	40	40	40	40	40	40	40	40	40	20
PUERTO RICO	20	20	40	40	40	40	20	20	15	15	15	15
SOUTH AFRICA	20	40	40	40	40	40	20	20	20	20	15	20
U.S.S.R.	40	40	40	40	40	40	40	20	20	20	20	40

WESTERN UNITED STATES TO:

GMT–	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	40	40	40	40	40	40	40	40	40	40	20
ARGENTINA	15	20	20	40	40	40	40	20	15	15	15	15*
AUSTRALIA	15	15	20	20	40	40	40	40	40	40	20	15
CANAL ZONE	15	20	40	40	40	40	40	20	20	15	15	15
ENGLAND	40	40	40	40	40	40	40	20	20	20	20	40
HAWAII	15	15	20	20	40	40	40	40	20	20	20	15
INDIA	20	20	40	40	40	40	40	40	20	20	20	20
JAPAN	20	20	20	20	40	40	40	40	40	40	20	20
MEXICO	20	20	40	40	40	40	40	20	20	20	20	15
PHILIPPINES	20	20	20	20	40	40	40	40	40	40	40	20
PUERTO RICO	15	20	40	40	40	40	40	20	20	20	15	15
SOUTH AFRICA	20	40	40	40	40	40	40	20	20	20	20	20
U.S.S.R.	40	40	40	40	40	40	40	40	20	20	40	40

*Possible 10 meter openings on Es dates.

Es means the possibility of a high MUF and/or freak conditions.



UHF Cavity Design

Jim Kyle K5JKX
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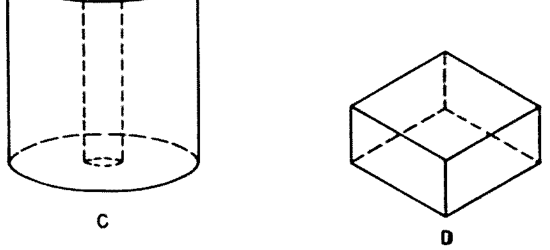
Oklahoma City 11, Okla

While thousands of published words have been expended on the subject of tank-circuit design for the lower frequencies, we've seen almost nothing in print in the ham magazines concerning design of cavities for UHF use. But with the rapidly growing move to ever higher frequencies, some idea of how to design a cavity is essential for the do-it-yourselfer.

"Why design a cavity?" you may ask, and the question is in order. The first answer is that you almost have to design one when you need it since they are not off-the-shelf items, and published designs (even) are few and far between. On top of that, any published design is almost useless to you unless you are using the exact same circuit and components—since cavity dimensions depend on a whole flock of variables, not just upon frequency alone.

So let's proceed into the only-partially-charted byways of the UHF regions, and take a look at how to design cavities:



TYPES OF CAVITIES
FIGURE 1

A good first step would be to examine just what a cavity is. By definition, a cavity is *any* space fully enclosed by conductive material. The shape of the space is immaterial, but will influence the frequencies of resonance. The cavity will be resonant at every frequency at which any dimension is an integral number of half-wavelenghts—and it follows automatically that every cavity has an infinite number of possible resonant frequencies.

However, this seemingly discouraging fact is of little immediate concern, because for our purposes we are using the cavity either as a filter or as a tank circuit, and in either case we are going to supply energy at a frequency which is at least approximately known. So long as only *one* of the infinite number of possible resonant frequencies is within the area we want to use, we will have no trouble.

Of course, should the cavity also be resonant to a low-order harmonic of our intended frequency, we might have problems. Fortunately, the most practical design types have resonances separated in such a manner that this problem seldom if ever arises.

By our definition of a cavity, it includes all shapes. However, design procedures differ for the different possible shapes. In general, they boil down to two major classes, with some subgroups. One class is that of "right cylindrical cavities," which if you recall high school geometry will be immediately identified as a section of circular pipe; the other is that of "prismatic cavities", which in more everyday terms means a closed box with six flat sides, such as a cube or a covered chassis.

The subclasses of the "right cylindrical" group include the reentrant cavity (the most general type), the pillbox cavity, and the coaxial line. The reentrant consists of a tube closed at each end, with a concentric post inside. A

"gap" is left between the end of the post and the far wall of the tube. Fig. 1-A shows a perspective drawing of a reentrant cavity.

The pillbox cavity may be thought of as the limiting case of a reentrant, in which the gap has been increased until it extends the full length of the cavity. Similarly, the coaxial line forms the other extreme, in which gap spacing drops to zero and the center "post" is connected to each end plate. Fig. 1-B shows a pillbox cavity, while the coaxial line is sketched in Fig. 1-C.

The prismatic cavity is shown in Fig. 1-D. Though it is easier to build one of these, the design techniques are so involved that we won't go into them here. Frequently, once design of a reentrant cavity is completed, you can transform it into a prismatic cavity of square cross-section without extreme difficulty. This, however, does not always hold true—if you try it after reading this, it's at your own risk.

Having met the four most common types of cavity (even though three are of the same general type, it's more common to speak of them as separate types for reasons which will become apparent as we continue); let's see how they work.

The job of a cavity is to determine frequency, and it does this by virtue of its dimensions. Detailed explanation of just *how* it does this leads us directly into Maxwell's field equations, complete with partial derivatives, so if you're interested we pass you to the references for details. What we're interested in here is the manner in which dimensions determine the frequency.

Most UHF enthusiasts are already familiar with the resonant line section and half-wave repeater. Briefly, a quarter-wave section of coaxial transmission line shorted at one end and open at the other acts like a tank circuit. Similarly, a half-wave section shorted at both ends also acts like a tank. This half-wave section is actually a coax-line cavity; in this case the length of the line is determining the resonant frequency of the cavity.

As we change the coaxial-line cavity to a reentrant type by introducing the gap at one end, and maintain the gap spacing constant, we will find that to hold the same resonant frequency the line must be shortened. As we shorten the line still more, keeping the frequency constant (as well as the gap spacing), we find that the diameter must be increased to maintain resonance.

When we reach the other extreme of the pillbox cavity by this process, in which the length (now called height since it is so small in comparison to some other dimensions) is the same as the gap spacing and the center post disappears, we will find that the resonant frequency is now controlled entirely by the *diameter* of the cavity. Under these conditions, we can make the height almost anything we want within reason and the resonant frequency will remain the same!

Thus we have seen that in the coax-line cavity the frequency is determined by length with diameter making little difference, while in the pillbox it's the diameter that counts and height has little effect. But how about that in-between reentrant that we sort of skipped over?

It's a complex problem, since in the reentrant four variables all work together to determine the resonant frequency. If any three are kept unchanged, the fourth will determine the frequency. But if two are varied at the same time, the frequency *may* just sit still! These variables are the cavity diameter, the post diameter, the gap spacing, and the height (or length).

At this point, let's pause for a moment and see how the characteristics of any tank circuit may be described. The usual specification at low frequencies is by inductance, capacitance, and load resistance (the last is not always specified as such but is inherent in any application). However, the tank can also be specified by resonant frequency, Q, and shunt resistance —a means of specification which is gaining in popularity as more homebrewers acquire grid-dippers. "Tune to resonance at 50 mc" is a not uncommon thing to see on a schematic these days.

In the cavity region, induction and capacitance tend to lose their meanings since they do not relate directly to any dimension. About the only way to specify a cavity is by resonant frequency and Q.

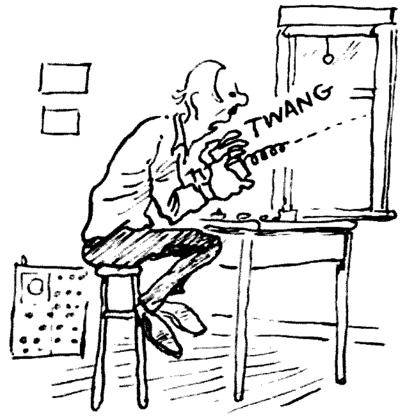
We have seen how certain dimensions control the resonant frequency. How about Q?

The Q (unloaded Q, that is) of a cavity depends primarily upon the rf conductivity of the material from which the cavity is made and upon the frequency of operation. However, it may be severely degraded by unwise choice of dimensions for the cavity.

For instance, we have seen how in the pillbox cavity the frequency is determined entirely by the diameter and that height is almost immaterial. But height of the pillbox can have an important effect on cavity Q.

It's almost obvious that if the height is reduced to zero the Q must also become zero, since the cavity as such ceases to exist. Actually, Q will have its maximum value with an infinitely high cavity—but this is scarcely practi-

I'M USING A NEW CONCEPT
IN CIRCUIT DESIGN...

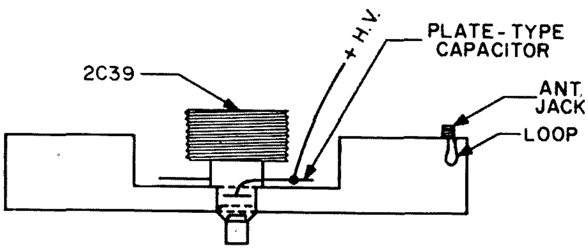


..SMALL SPRINGS FACILITATE
EASY PART-REMOVAL ...OOPS!

THAT POWER XSTOR COST ME #15!

LADY, MAY I GET MY TRANSISTOR
OFF YOUR HAT?

SOMETIMES EXPLANATIONS
ONLY CONFUSE THE ISSUE



TUBE IN REENTRANT CAVITY
FIGURE 2

cal. It will still have half of this maximum value when the height is reduced to 0.192 wavelength. Therefore, if the height is kept greater than 1/5 wavelength it will do little harm to the Q of the cavity.

As height decreases, so does Q—but not in a straight-line manner. To reduce the Q to one-tenth of its theortical maximum value, the height would have to be reduced to 0.021 wavelength. Since this represents a cavity only about ¾ of an inch high at 300 mc, where the diameter would be about 30 inches, and since a Q of one-tenth maximum would still be in the neighborhood of 1,000, you can see that any reasonable height is satisfactory from a Q standpoint.

Similar conditions prevail in the coax-line cavity. Here, Q will be at its maximum for a certain definite ratio of conductor diameters, which gives a characteristic impedance of 77 ohms. With this ratio fixed, the Q will be maximum when cavity diameter is infinite, and will approach zero as the diameter approaches zero. However, again, within practical limits the diameter (and even the ratio of diameters) is immaterial.

In the reentrant cavity, all the factors which affect frequency also have their effects upon cavity Q. Due to the interactions between the four variables, little can be given concerning the ways in which these effects show up. However, in practice all will be negligible.

All the foregoing, of course, assumes that the interior surface of the cavity possesses good rf conductivity. If you build a cavity out of nichrome, naturally its Q will be way down. But with 5-mil silver plating, Q values will be far greater than you have been used to seeing at the lower frequencies. A Q of 1,000 would be astronomical for a conventional coil—it's considered pretty low for a cavity!

And up to this point our discussion has concerned unloaded cavities. They're nice from a theoretical point of view because nothing from outside the cavity has any effect—but for the same reason they are useless. To make use of a cavity in any way, we must load it in some way, either by coupling it into a transmission line to act as a filter, or by coupling it to the plate of a tube to act as a tank circuit.

Coupling to any cavity may be accomplished in either of two ways: electric coupling, by use of high-impedence capacitive coupling to its electric field, or magnetic coupling, an inherently low-impedence technique for coupling to the magnetic field of the cavity.

Electric coupling is accomplished by either inserting a probe (or miniature antenna) into the cavity at a high-impedence point in the cavity, or by placing an electron tube across the highest-impedence point in the cavity so that its plate is connected to one side of the cavity and its cathode to the other. An example of this latter type of coupling is shown in Fig. 2. The ease of this type of coupling makes the reentrant cavity a natural for tank-circuit use.

Magnetic coupling is accomplished by inserting a loop into the cavity; the usual place is near a corner or across one end. The antenna coupling circuit shown in Fig. 2 is of the magnetic variety, illustrating the difference between magnetic and electric coupling.

Not yet discussed, but very important in actual cavity design, is the effect of lumped capacitance upon the cavity's action. For example, the plate-cathode capacitance of the tube in Fig. 2 is directly across the highest-impedence point in the cavity. To design the cavity rather than just build it, the effect of this added capacitance must be taken into account.

Unfortunately, mathematical design procedure for cavity resonators takes no account of the exact effects of such lumped capacitances except in the special case of the coax-line cavity. In the coax-line, the effect of lumped capacitance is to electrically lengthen the line. The resulting effect is expressed by the formula shown in Fig. 3, which states that the effective line length of the line itself in electrical degrees is equal to the angle whose tangent multiplied

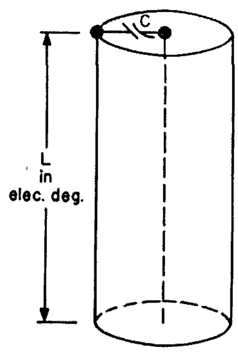
FOR RESONANCE:

$X_c = Z_o \operatorname{Tan} L$

Given C and L:

$$f = \frac{0.159}{C \cdot Z_o \cdot \operatorname{Tan} L}$$

where f is in Mc if C is in μμf and Zo is in ohms



LOADING A COAX CAVITY
FIGURE 3

TABLE I—Thermal Qualities of Some Cavity Materials

Material	Expansion Coefficient PPM/degree F	Frequency Change in cps/mc/degree F
Steel	6	6
Copperclad Steel	7	7
Copper	10	10
Yellow Brass	11	11
Aluminum	13	13

by the line impedance is equal to the capacitive reactance of the lumped capacitance. Or, in simpler language, the line is tuned to a lower frequency which can be calculated.

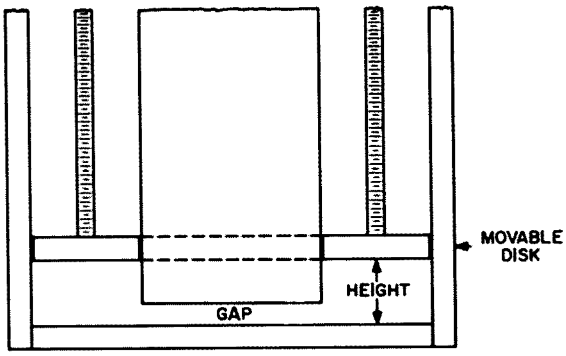
Addition of lumped capacitance to the other types of cavity resonators also lowers the resonant frequency, but calculation of the exact amount by which the frequency is lowered is a much more difficult problem. The most practical way for the homebrew ham to take this factor into account is to design the resonator for a frequency approximately double that which he desires, then load the cavity with additional capacitance after tubes are installed until it resonates at the desired point.

This specific factor—lack of knowledge concerning the exact effects of capacitance loading upon the characteristics of a cavity—is one of the biggest drawbacks in cavity design today. It makes successful design of a "ring amplifier" a tedious, cut-and-try process instead of the simple procedure it at first appears to be. Some of the more ambitious UHF men, such as K2TKN, have gone to the lengths of building specialized laboratory test equipment in attempts to learn more about these factors; their results will be interesting and useful.

Before moving on to discuss the actual procedure for design of a cavity, let's spend a couple of minutes looking at some purely mechanical—but still important—factors which influence the frequency stability of the finished cavity.

It's well to remember that the dimensions of the cavity are the major influence upon its resonant frequency—and all materials change dimension under the influence of temperature. Thus you should choose the material for the cavity not only on the basis of its strength, expense, or conductivity—but also on the basis of its thermal coefficient of expansion (how much it changes size when it gets hot).

These coefficients of expansion are listed in Table 1 for the more popular cavity materials, together with the frequency changes in cycles per megacycle per degree F. As temperature rises, the frequency will increase. Note that the old chassis favorite, aluminum, comes in in last place in this listing! And the listing is in



TUNING REENTRANT BY VARYING HEIGHTH
FIGURE 4

order of desirability, with the most stable materials at the top of the table. Probably the most reasonable compromise would be the use of copper, which combines good plating qualities, good expansion properties, and ease of working.

The resonant frequency of the cavity will also be affected by the humidity—and this you have precious little control over. Taking 60 percent relative humidity as the starting point, an increase of humidity to 100 percent will cause the frequency to decrease by 0.006 percent—a change of 6 kc per megacycle. Decreasing humidity to 20 percent causes frequency to increase about the same amount. Changes of air temperature have similar effects but of much smaller degree.

Since you can't do much about humidity effects, it might seem pointless to mention them. However, they are mentioned just so you will know about them when they show up. They can be compensated for by retuning the cavity at each use.

Speaking of tuning, we have so far made no mention of it, although obviously a practical cavity for ham use must make some provisions for frequency adjustment.

As we saw earlier, a cavity may be tuned by adjustment of its length, or, if it is of the reentrant type, by changing the gap spacing. The length may be adjusted as shown in Fig. 4. The gap spacing, similarly, may be changed by the technique shown in Fig. 5.

If tuning is done by changing the length, frequency will decrease as gap spacing detuning is by means of changing gap spacing, frequency will decrease as gap spacing decreases.

Another method of tuning a cavity, frequently used in ham construction, is that shown in Fig. 6. This uses a modified neutralizing-capacitor plate to change the value of a lumped capacitance in the cavity, and its effect on a given cavity is difficult to predict. As capacitance increases, however, frequency will decrease.

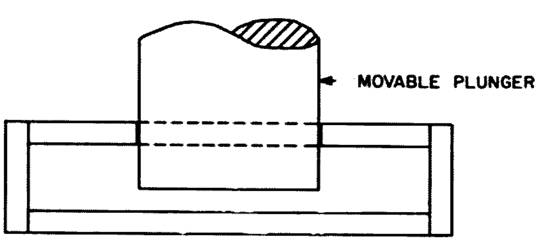
So now, after all the background and theoretical material, we're ready to attack the problems of actual cavity design.

Design of a coax-line cavity is simplicity itself; simply divide the wavelength corresponding to the desired resonant frequency by two, multiply by the velocity factor of the line (if you are using a solid coax—otherwise this is irrevelant, since the velocity factor of an air-filled line is 1.0), and you have the length. Diameters can be whatever you require. Remember, though, to design for a frequency approximately twice that at which you intend to operate, to allow for loading effects and have room for tuning.

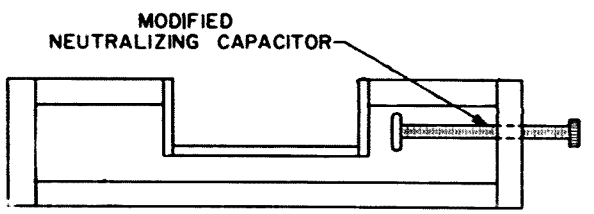
For a pillbox cavity, divide the wavelength corresponding to design frequency by 2.61 to determine the radius of the cavity; diameter will be twice this figure. Height is immaterial so long as it is greater than 0.021 wavelength.

However, both coax-line and pillbox cavities find only limited ham applications. By far the most useful all-around cavity design is the reentrant style—and since its design involves a function of not one but four variables, design charts are necessary.

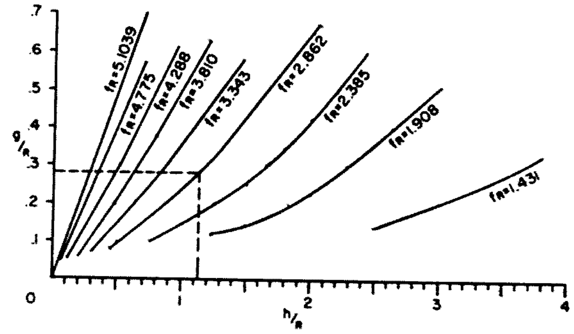
Figs. 7 and 8 are a pair of these charts; Fig. 7 applies to reentrant cavities in which the ratio of diameters of the center post and the cavity itself is 2.25, while Fig. 8 is for a diameter ratio of 3.50. For intermediate diameters, these charts will give a range of values and the desired values will lie within this range.



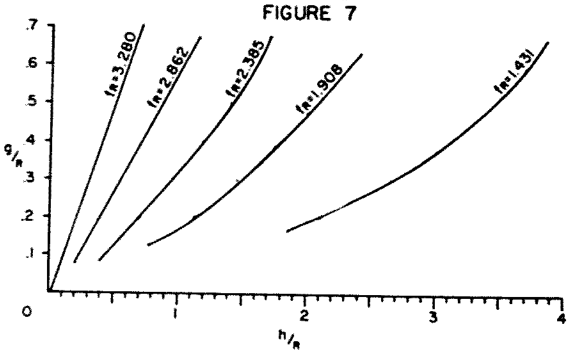
TUNING REENTRANT BY VARYING GAP
FIGURE 5



CAPACITOR TUNING OF CAVITY
FIGURE 6



RATIO = 2.25
FIGURE 7



RATIO = 3.50
FIGURE 8

Frequency is shown in kilomegacycles—this will be true only if all dimensions are measured in centimeters. The conversion from centimeters to inches follows the equation 2.54 centimeters equals one inch.

These charts are somewhat complex and their use is best shown by working out an example. Let's design a cavity to operate at a frequency of 1296 mc and using a cavity diameter of 4¼ inches. A center post diameter of 1¾ inches will result in a diameter ratio of 2.25, so we now turn to Fig. 7.

The small amount of specification we have already done has fixed the values of two of our four variables, leaving only gap spacing and cavity height to determine from the chart. But before we can do this, we must determine which of the frequency lines to use.

Note that gap spacing, cavity height, and frequency are all given in terms of their relationship to center-post *radius* (rather than diameter). Thus, our first step is to convert the center-post diameter of 1.75 inches to a radius in centimeters. Multiplying the inch measurement by 2.54 converts to centimeters, and dividing by two converts diameter to radius. Our figure (calculated by a six-place log table) is 2.2225 cm; we round off at this point to 2.2. Multiplying this by the design frequency in kmc (1.296) gives us 2.8578; using the line marked 2.862 will be plenty close enough for our purposes.

Next step is to note the possible range of values covered by the frequency line chosen;

in this case gap spacing can range from a g/r of 0.08 to 0.67, with corresponding h/r values from 0.42 to 2.05. Converting these figures to centimeters by multiplying them by r (2.2) we find that gap spacing can range from 0.176 cm (less than 1/10 inch) to 1.474 cm (just over half an inch). With the smaller gap, height will be 0.924 cm (about ⅜ inch) while with the larger one, height will be 4.51 cm (just over 1¾ inches).

From these ranges, we can pick either the gap spacing or the cavity height we prefer, and the other dimension will then be read from the curve. Let's choose a gap spacing of ¼ inch just to illustrate how the process works.

After converting the ¼-inch spacing to centimeters and dividing it by r, we come up with a g/r value of 0.285. We locate this value on the g/r scale by interpolation (dotted line in Fig. 7) and follow over until it intersects the frequency line marked 2.862, then drop vertically to the h/r scale (dotted vertical line) to find the h/r value. In this example, it is 1.11. Multiplying by r, we obtain 2.442 cm as the height of our cavity—or just under one inch.

The final cavity dimensions, in inches, then become a diameter of 4¼, a center-post diameter of 1¾, a gap spacing of ¼ inch, and a cavity height of 0.961 inches. Making the top plate variable as shown in Fig. 4 allows easy variation of cavity height to allow for final tuning of the cavity.

In this example, we chose a frequency and a diameter, and from those determined the rest of the cavity dimensions. But what if we are free to use any diameter we want—how do we pick the most suitable value with these charts?

A good starting point would be to divide the frequency into the values marked on the frequency lines. The results you get will be the range of center post radius values covered by the charts; they will range from a minimum of 0.43 cm for frequency line 1.431 and frequency of 3300 mc to as much as 100 cm (39.4 inches!) for a frequency line of 5.00 and frequency of 50 mc.

Once you pick a suitable center post radius, multiply it by either 4.5 for Fig. 7 or 7.0 for Fig. 8 to determine cavity diameter; the choice of which to use is yours, remembering that the larger-diameter cavity tunes to a lower frequency, all other dimensions being equal.

From this point, simply continue as previously described, except that you have already determined the value for r (center post radius) so it need not be recalculated.

If you would like additional curves for other diameter ratios, you can find them on pages 73 through 75 of "Klystrons and Microwave Triodes", a volume of the MIT Radiation Laboratory Series published by McGraw-Hill and available in many libraries. However, you should seldom need them.

We hope that this material is of some help to the would-be UHF experimenter; those looking for more data can find it in the above-mentioned volume, as well as in *Reference Data for Radio Engineers* published by ITT-Kellogg and to a lesser extent in the past three editions of *Radio Handbook.* Both these volumes are available from Radio Bookshop.

Dual Antenna System for Mobile

Frank Mohler W2IAZ
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Eatontown, New Jersey

A motorist is already familiar with a dual roadway which reduces congestion on highways. Use of the dual antenna system offers similar relief from overcrowded airways for the modern mobileer.

Some Mobiling Problems

Did you ever work mobile and encounter the following frustrating situations? Situation 1—You are in contact with a local station on 75 meters. As you travel away from his station he reports that QRM is beginning to clobber your low-powered signal. His signal is loud and clear in your mobile receiver and you would like to continue the QSO. What can you do? Or take situation 2—You are looking for a local QSO to get information about the unfamiliar area through which you are traveling. You take a look-see over the different bands with your receiver and tune in a local roundtable on the 75 meter band. You would like to get into this net but your antenna is a 15 meter whip and the 75 meter heliwhip is stored inside the car. To change antennas would take about a minute or so but to perform this change requires that you stop the car. In many cases, such as

when driving on the Freeway or other public racetrack, you are unable to stop the car and perform this operation in safety. What can you do? Or take Situation 3 which happens all too often—You are tuned up on 75 meters but the band is so congested that all attempts to raise a contact are fruitless. You then tune the receiver across the other bands and hear the familiar voice loud and clear on the 15 meter band. It's old buddy Jake that you haven't worked "in a long distance." He is telling someone that he is about to QRT and will stand by for any final remarks before pulling the big switch. Band conditions are good and you know from past experience that you can snare good old Jake if only you had the 15 meter antenna on your transmitter. You have only seconds in which to change antennas and tune up on 15 meters but there isn't time for you to find a safe place to stop the car and make the change. What can you do?

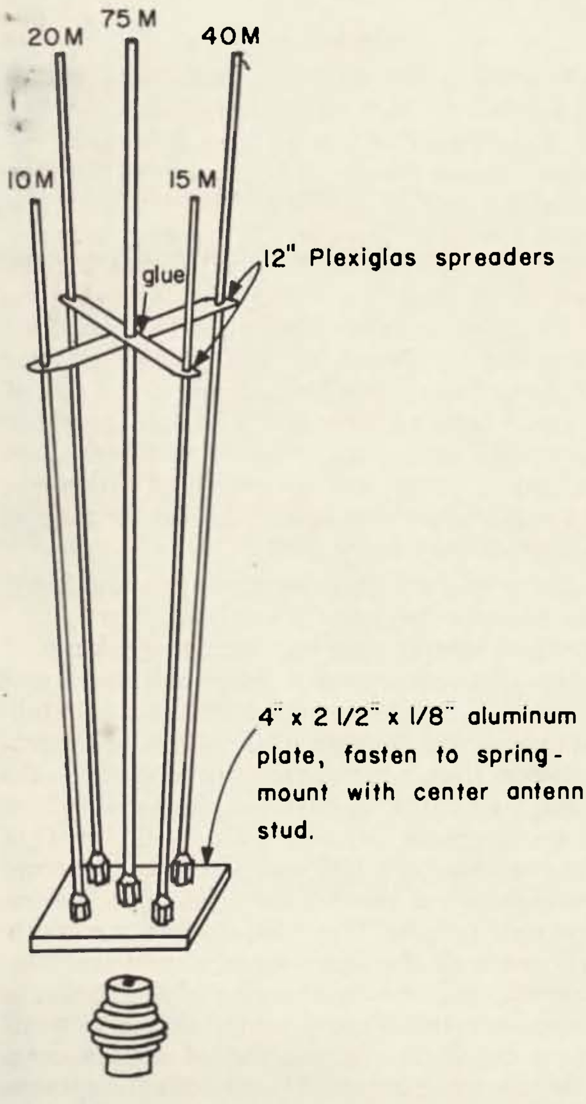


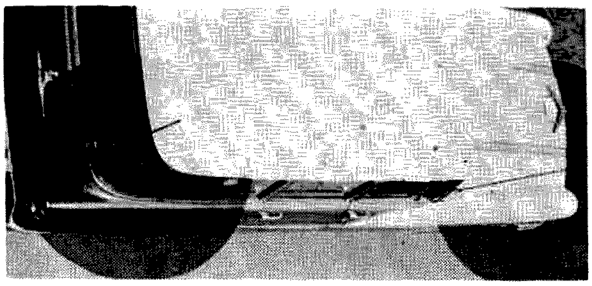
FIGURE 1

A Few Solutions

The obvious solution to such frustrating predicaments is to be prepared with an all-band antenna system that will permit you to band-hop in seconds. What is equally important, but often overlooked, is the ability to change bands without having to stop the car to make antenna adjustments.

One method for accomplishing this is to install an autotune system in which a remote-controlled reversible motor is used to tune a base-loading antenna coil. The disadvantages of cost, complexity, and low radiation efficiency make this method too unapealing to me.

A second method is to install the Umbrella Stand or Porcupine Array shown in Fig. 1. The bristling appearance of this all-band mobile antenna system is so startling that I recommend its use only to those who have exceptionally strong gastric systems. As I say, this method will work if you can (UGH) stand the sight. Technical details are shown in Fig. 1. The aluminum adaptor plate will accommodate sepa-

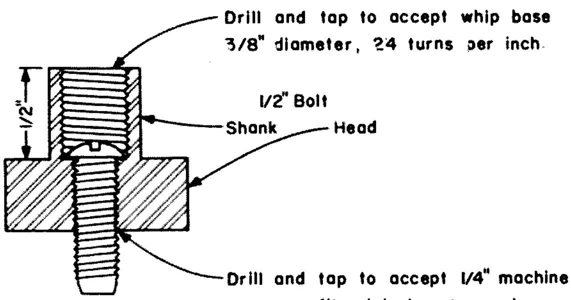


rate heliwhips for five different bands. Removal of the cented heliwhip allows rapid disassembly for traveling through civilized areas.

As a compromise solution, the mobileer might try the dual antenna system that is relatively uncomplicated, is presentable in appearance, and is guaranteed to double your enjoyment of mobile operation.

Dual Antenna System

The idea is simple enough. Just mount two antennas on the car; one at the front, and one at the rear. Then connect both transmission lines—yes, BOTH of them—to the transmitter. I use a T-junction coaxial fitting on my transmitter to make this connection. In my mobile station, I normally use a 15 meter heliwhip mounted on the front fender of the car and a 75 meter heliwhip mounted on the rear bumper. Purists can install and use an additional selector switch at the transmitter to permit alternate use of either antenna. I learned that such a switch is an unnecessary luxury, for on trying the dual antenna system I found that each antenna performed normally. Apparently, the correct antenna doesn't know or care that a wrong antenna is also connected to the transmitter. To change bands can be done without stopping the car or fiddling around with roller adjustments, sliding contacts et al. With my bandswitching transmitter, I can bandhop in the same time it takes to tune a receiver to a different band, a matter of seconds.



ANTENNA BASE ADAPTER

FIGURE 2

Advantages of the Dual Antenna System

Now how does this dual antenna system offer the solution to the situations discussed at the beginning of this article? Take the first situation—The other station is beginning to lose you because of QRM on 75 meters. The solution: Tell him, even if you do have to repeat 5 or 6 times that you will QSY to 21.3 mc but will continue to listen to him on 75 meters. From experience, this method works almost all of the time and allows a satisfactory continuation of the QSO which otherwise would have been unhappily ended.

Situation 2 as well as Situation 3 offers no problem when this dual antenna system is used. Without stopping the car to make antenna adjustments, you merely bandswitch your transmitter to the alternate band. In less time than it takes to say, "Allagazandas Ragtime Bebop" you can be working out on the alternate band and you have a good chance of hooking old buddy Jake before he pulls the big switch.

Installation Tips

Because of the relatively short length of the 15 meter heliwhip, I mounted this antenna on the front fender of my car. I used the same antenna mount which had been used for the broadcast receiver antenna. The particular antenna mount on my car (56 pontiac) was designed to accept a ¼-inch threaded stud. To permit its use with the standard ⅜-inch stud on transmitting mobile antennas, I fabricated an adaptor plug shown in Fig. 2. This adaptor plug was made from the head and shank part of a ½-inch bolt, which was drilled and tapped as shown in Fig. 2. I suppose any ¼ to ⅜-inch adaptor can be purchased and used, but if they are not available in your area, this idea for making it yourself may be helpful.

Because of its short length (approx. 4 feet), the 15-meter heliwhip is mounted directly into the front mount without a spring shock-mount base. The appearance is quite shipshape and attractive. A spring shock-mount base is installed on the rear bumper of the car to accommodate the 75-meter heliwhip (or alternately the 40, 20, and 10 meter whips). The spring base is not necessary for use with the lightweight flexible heliwhips but was installed to permit alternate use of less flexible types when making comparison tests. I use RG-8 coaxial cable to connect both the front-mounted and the rear-mounted antennas to the coaxial T-junction at the transmitter located under the dash panel of my car. Both antennas are fed simultaneously by the transmitter, although only the antenna which is resonant to the transmitter frequency

will act like it is in the system.

Operating Suggestions

When using the dual antenna system in mobile operation, I find that a certain technique is worth practicing to avoid unsatisfactory completion of a QSO. While in contact with another station, I will make it a point to explain that I can switch instantly to an alternate band if deteriorating band conditions cause a serious reduction in signal readability. For example, when working on 75 meters, I generally inform the other station operator that my alternate frequency will be 21.3 mc in the event of serious interruption or interference to my signal. Instantaneous switching to an alternate, less congested, band has enabled me to complete mobile QSO's which otherwise would have been left dangling in midair like ____ you____ beginning ____ ____ 50 percent ____ sput ____ ____ lose ____ sputter ____ 73 ____ phfitt.

. . . W21AZ

Eliminating Polar Relay Hash

George Oberto K4GRY

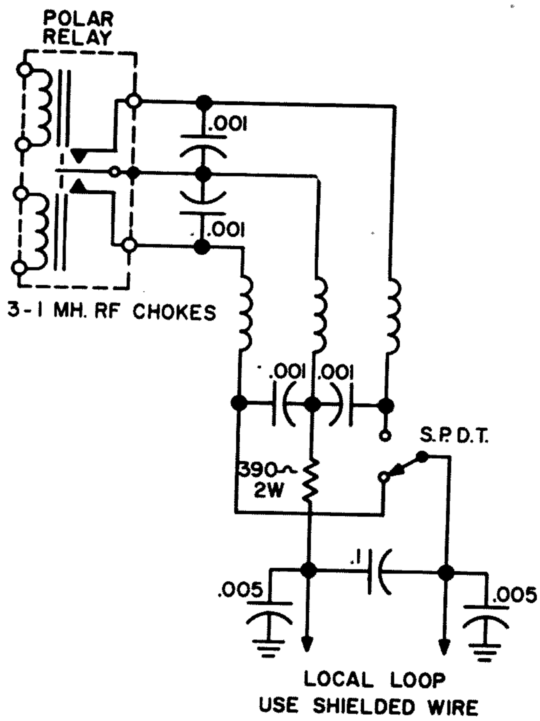
Vacuum tube or transistor type keyers feeding directly to the selector magnet of a teletype printer is often preferred by most radioteletype enthusiasts, because of the elimination of the polar relay with its radiated hash problems. If we can get rid of the troublesome relay hash, a properly adjusted polar relay is preferred, because of the extra range that will enable us to dig down in the QRM for the weaker RTTY signals.

In using several RTTY converters, with and without a polar relay, it was decided to try and eliminate the troublesome hash from the polar relay contacts, keying a 60 ma loop, feeding the selector magnet of a model 15 page printer.

The circuit uses several of the popular methods to adequately suppress the polar relay hash. Four .001 mfd ceramic capacitors are wired, as shown, two across the bottom and two across the top of the three 1 mh rf chokes. At the bottom of the rf chokes the popular hash suppression circuit consisting of a 390-ohm 2 watt resistor and a .1 mfd capacitor is utilized. A .005 mfd ceramic capacitor is wired from each side of the .1 mfd capacitor to ground.

The entire assembly is installed in a small aluminum minibox and all wires including the printer cord are well shielded (using two wire shielded cable) with the printer, converter, and receiver connected to a common ground; preferably a cold water pipe or a ground rod driven deep into the earth. The receiving antenna should use coax cable to feed the antenna. The end result is the elimination of all traces of radiated hash from finding its way into the receiver's antenna system.

. . . K4GRY



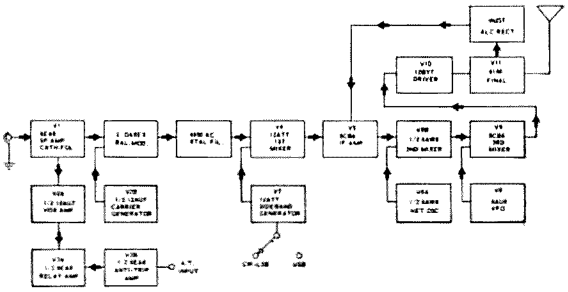
73 Test the Heath HX-20

Robert Buaas K6KGS

Heath Company calls their new HX-20 a MOBILE SSB TRANSMITTER. All this it is, and more. Compactly packaged is a complete filter SSB transmitter/exciter for mobile, portable, or fixed use. Advanced mechanical and electrical design make the HX-20 a real performer. Modern styling and "ease-of-operation" make this unit a natural mobile transmitter. It is the opinion of the author that Heath has come out on top AGAIN.

The HX-20 sports an 11 tube circuit (not to mention the 7 diodes and 2 gas voltage regulators) that emits 100 watts PEP of USB, LSB, and CW. Associated circuits provide VOX, ANTI-TRIP, ALC, receiver muting, and antenna switching. Provision is made to "spot" the VFO either by "talking it on frequency" or by inserting carrier and zero-beating.

The HX-20 was designed to be used with the HR-20 in a mobile installation. Simply connect the two together, add a power source (such as the Heath HP-10), microphone, speaker, and an antenna, and you're on the air. In the mobile lash-up, total power draw on the battery on voice peaks is 150 watts, from a 12 volt dc source. Receiving power is 80 watts. All oscillators in the HX-20 run continuously, accounting for the additional power drain.



BLOCK DIAGRAM

For fixed use, the HX-20 may be used to excite a 1 KW linear amplifier (such as the Heath HA-10) or may be operated "barefoot." The 6146 power amplifier develops up to 50 watts average output on all bands. Hetrodyne circuitry and temperature compensation of the VFO are used to obtain maximum frequency stability and image rejection.

A block diagram of the HX-20 is shown in Fig. 1. As one might imagine, the schematic is very involved, thus it was omitted here. A triple-conversion hetrodyne circuit is used to obtain SSB at the desired output frequency. All oscillators are crystal controlled, with the exception of the VFO, of course.

Audio from a high-impedience microphone is amplified in the pentode section of a 6EA8. The triode section of the same tube acts as a cathode follower to provide the proper match for the crystal filter. A sample of this audio is amplified in ½ a 12AU7, the VOX amp. This VOX audio is rectified and used to control the relay amp, the triode half of a 6EA8. The other half of the 12AU7 is used as a carrier generator for the crystal filter, the frequency being crystal controlled at 4990 kc. Output of this stage is coupled to the Balanced Modulator, two matched germanium diodes. A path for inserting carrier is provided for tune-up and CW operation.

The lower sideband of the DSB suppressed-

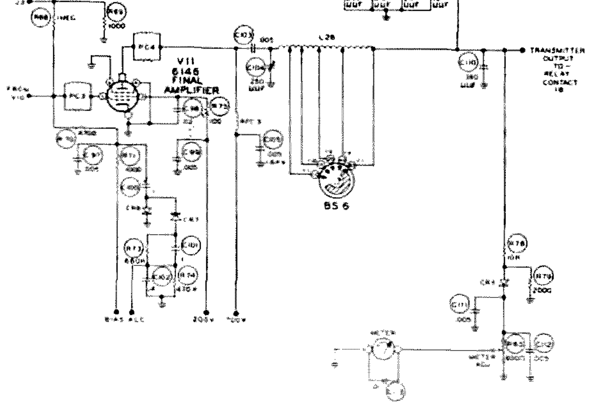
carrier signal obtained in the balanced modulator is suppressed in a crystal lattice type filter. It passes frequencies from 4990.0 to 4992.7 kc approximately. The low-Z output of the filter is connected directly to one grid of a 12AT7 "first-mixer."

USB or LSB may be selected directly. Another 12AT7 is used for two crystal oscillators so that the sum or difference frequencies of the USB signal at 4990 kc and the crystal oscillator selected will produce a 9000 kc USB or LSB signal respectively. Thus, the xtal freqs. are 4010 and 13990 kc. Provision is made for tuning the USB and LSB carrier freqs. to the same frequency. The output of the first-mixer is tuned to 9 mc in a Hi-Q double-tuned *if* transformer.

A single 6CB6 increases the 9 mc SSB signal to a usable level. The plate circuit is again a Hi-Q transformer. ALC voltage is used to bias this stage to keep from driving the final amplifier into the non-linear region. In the CW mode of operation, the "Drive" control on the front panel allows the operator to set the amount of cw output. This feature is an asset in tuning up the rig "on-the-air" without hetrodyne QRM.

Nine mc SSB is coupled to the second-mixer, the pentode section of a 6AW8. The triode section of this tube is used as a xtal controlled hetrodyne oscillator, providing the second mixer with injection voltage. The output of the 6AW8 mixer is tuned 5 mc higher than the output frequency selected by the bandswitch. Hi-Q slug tuned circuits and traps are used. SSB from the second mixer is fed to the third-mixer, a 6CB6.

Injection voltage for the third mixer comes from the VFO, an electron coupled serier tuned Colpitts oscillator. Plate and screen voltages are regulated by an OA2 gas regulator



tube. Electrical stability is excellent: the capacitors in the frequency-determining tank have three different temperature co-efficients. Only 3 milliamps are drawn through the 6AU6, contributing more to the electrical and thermal stability.

The difference frequencies found at the plate of the third mixer are selected with Hi-Q slug tuned circuits, connected in the plate circuit by the bandswitch. These tanks are tuned to the output frequency, one for each band. Output of the 6CB6 is amplified in the 12BY7 driver, which is again resonated to the output frequency in the plate circuit. The third mixer and driver plate tanks are "gang-tuned" to reduce the number of front panel controls and to simplify tune-up. This control is labeled "Driver" on the front panel.

Blocking bias is connected to the control grids of the third mixer and driver stages, rendering them inoperative during standby periods. The output freq. is "spotted" by unbiasing these stages. Grid-block keying is used in CW, providing no key clicks or chirp.

The plate of the 12BY7 driver is capacity coupled to the 6146 Final Amplifier. Control grid bias is regulated at -50 v by an OC2 voltage regulator and resistance voltage divider. Screen voltage is regulated at 200 v by a tap on the voltage divider supplying the VFO OA2 voltage regulator. A fixed loaded pi-network is used in the final amp. plate circuit. The input of the pi-net is resonated to the output frequency with a 250 mmfd variable capacitor labeled "Final" on the front panel. The output impedance is fixed, chosen to match a 50 ohm non-reactive load. An rf "sniffer" samples a small amount of the output. This signal is rectified and displayed on the relative output meter on the front panel.

An interesting feature of the HX-20 is the ALC circuit. Fig. 2 shows a schematic diagram of the final amp and the ALC. ALC voltage is applied to the 9 mc *if* amplifier control grid in the form of negative bias. When the final draws no grid current through R71, the 1K grid resistor, no ALC voltage is developed and the *if* amp operates at maximum gain. When grid current starts to flow, a voltage drop appears across the IK resistor, the waveform of which is that of the input speech peaks. This voltage is coupled by C100, a .1 mfd capacitor, to a voltage doubler circuit, CR1 and CR2. The ALC voltage decreases the gain of the *if* amp., reducing the drive, thus bringing the final back into linear operation. A sample of the rf drive at the final grid is returned to the receiver for spotting the

VFO. The "sniffer" circuit is also shown in Fig. 2.

Anti-trip audio from the receiver is amplified in the pentode half of a 6EA8 and rectified to provide negative bias to compensate for receiver pick-up in the microphone. This negative anti-trip voltage is applied to grid of the VOX relay amp along with the VOX voltage.

Some hold-up in production must have existed at Heath when the author ordered his HX-20 because it was back-ordered two weeks. The kit was well packed; no damage was found on unpacking. Even the cardboard box survived the 2500 mile trek in one piece. All the components are of highest quality, as in the HR-20. All tube sockets are ceramic. The output coil is wound on a 2" ceramic form. Parasitic suppressors are used in the Driver and Final Amplified stages. All leads at rf ground are well by-passed. Twenty-two heavily plated steel brackets make up the HX-20 chassis and internal shields. When bolted together, these parts make an extremely rugged framework. VFO drive gears are spring loaded to eliminate backlash. This rugged construction and spring loading contribute greatly to the excellent stability of the VFO. Although the HX-20 is well shielded, it is not difficult to build. Heath says that approximately 45 hours of construction time is required. The amount of time required varies with the experience of the builder. This figure represents the time required of a relatively inexperienced constructor. Patience is of the essence in the building of this kit. In places, components are wired 4 and 5 layers thick. A very professional job of wiring can be achieved if the builder carefully studys the instruction manual previous to picking up the screwdriver and pliers.

Upon completion of wiring, the HX-20 was given a thorough resistance check before power was applied. Finding no errors, power was turned on; no smoke resulted. Alignment is straight forward, and no re-peaking was required. A VOM will not work when one is tuning up the hetrodyne oscillator. An 11 meg input VTVM must be used. Even then, grid voltage was found to be a little below specified on 10 meters.

Since the author dislikes the use of RCA phono connectors at RF, BNC type UHF connectors were used in place of the connectors supplied. The phono connectors would, no doubt, work well, but the authors HX-20 and HR-20 are moved from the rack in the mobile regularly, placing undue wear on the coax cables. It was found that straight through operation of the 6AW8 second mixer on 75 meters did not supply enough drive to the 6CB6. Thus, the 2.7K resistor, R38, was changed to 4.7K, 1 watt. This solved the problem.

The specification sheet states that carrier suppression is 50 db while suppression of the unwanted sideband is 55 db. The proof of the pudding was the "on-the-air" test. Excellent reports were received, on both quality and signal strength. Frequency stability is remarkable. The HX-20 was clamped in a paint mixer and allowed 30 minutes to warm up. After warmup, the output frequency was hetrodyned with a 10 meter harmonic of the 100 kc frequency standard. After 15 minutes

of vigorous mixing, the HX-20 had moved only 1500 cps. Someone try this test on a 32S1. No one has volunteered the use of one here, yet!

Other than the stability test, the HX-20 was compared with a KWM-2. The HX-20 lacks the frequency "re-setability" that the KWM-2 possesses. Careful interpolation can bring the HX-20 within 1.5 kc, whereas the M-2 can come within 200 cps. There is only 3 db difference in power output. VOX, ANTI-TRIP, and ALC tied for first. As far as size goes, the KWM-2 is a transceiver and the HX-20 is a transmitter. No valid comparison can be made. Note gents that the HX-20 is just a tad smaller than the 32S1.

For the money, it will be extremely hard to de better than the HX-20. It is the opinion of the author that the HX-20 and HR-20 make one of the best rigs on the air today—with the added consolation that one does not have to sacrifice one of his gold fillings.

. . . K6KGS

Remotely Controlled Variable Inductor

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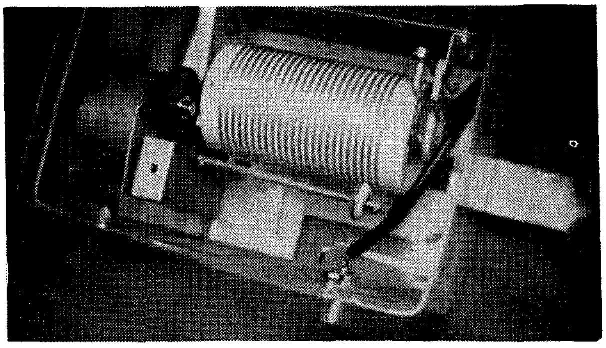
Brooklyn 14, New York

I faced the problem of changing antenna inductance in relation to ground potential. When I decided to become sophisticated and raise my 32' vertical plus coil from 40' (roof-top) to a height of 71'. Although the physical transferral of the antenna to its new position was made without difficulty, when my bridge and dipper were placed on the line, I was shocked to note the resonance change. Since I am somewhat inhibited about climbing to the tops of swaying towers, some remote means of altering inductance was needed. A system controlled from the shack was the answer.

Since I am new to amateur radio I had originally turned to the Command series of transmitters for a first rig. My original purchase was an 80 meter BC-696. The variable inductor (to resonate long wires) had been removed and thrown into the junk box. After meditating for a long period of time, this piece of valuable, equipment was exhumed from the maze of wires, tubes, shoes and other choice bits of equipment that make up the average ham



shack. This undistinguished bit of equipment was to provide the solution to this quasi-intricate dilemma. I realized that variable inductance, controlled remotely was feasible and extremely inexpensive.

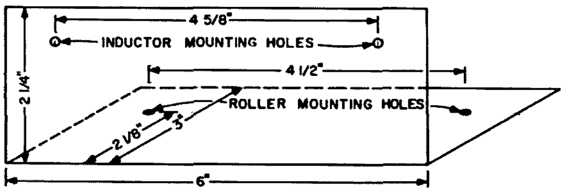
The parts required are:

1 5" x 7½" x 4" plastic food container & cover
1 female co-ax connector
1 1-5 rpm motor (Barry's Elect. NYC, $1.59)
2 right angle fittings constructed from scrap
a. 6 x 3 x 2¼"
b. 3½ x 2 x 1¾"

The right angle supporting the variable inductor is cut and tapped as per Fig. 1.

The small right angle is cut from scrap metal to provide the mounting for the motor. The dimensions are as per Fig. 2. In my case the

(Turn to page 58)



RIGHT ANGLE FOR VARIABLE INDUCTOR
FIGURE 1

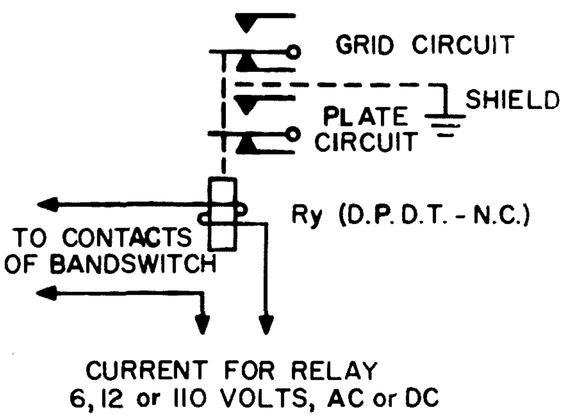
Efficient Bandswitching

In building or designing that new bandswitching transmitter, receiver, converter, signal generator and so forth with one or several bands at a VHF frequency, it is best that the leads be short and direct as possible, and the grid input and plate output wiring properly isolated from each other to obtain maximum circuit efficiency.

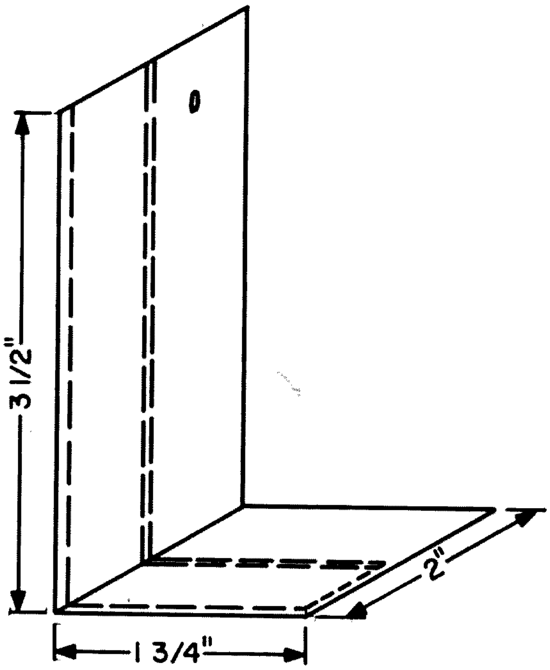
It often being the case, it is impossible to get that grid or plate circuit wired into the the bandswitch properly. A simple way to overcome this is to use one or more relays in conjunction with the bandswitch when switching to a VHF band. The relays can be a dpdt, spdt, or what we need for switch contacts, and by mounting the relay close to the grid input and plate output circuits this results into a well performing circuit.

To control the relays the band switch is wired up to energize the relay solenoid when switched to its band position on the bandswitch. Six, 12 and 110 volt ac or dc relays will work okay and be sure that the current drain of the relay solenoid is low to prevent pitting of the bandswitch contacts.

. . . K4GRY



USE AS MANY RELAYS AS NECESSARY FOR LOW-LOSS BANDSWITCHING AT VHF.



MOTOR MOUNTING BRACKET
FIGURE 2

sheet metal needed to be reinforced by a heavier angle. I felt it was easier to work with this material and later slip heavier gauge metal into position for the extra support. Needless to say, one could construct this support at the outset in a heavier material. The additional brace is portrayed by the dotted line in Fig. 2.

A careful examination of the roller indicated that the thumb wheel originally used to drive the inductor could be removed. This was tapped with a small drill and threaded roughly with a bolt of comparable size. This gear was then placed on the shaft of the motor with a bit of glue judiciously applied to lock this assembly. The motor and gear were then placed on the small right angle and only *one* hole was drilled to accommodate this mechanism. This was done to allow the motor to pivot on a lobed

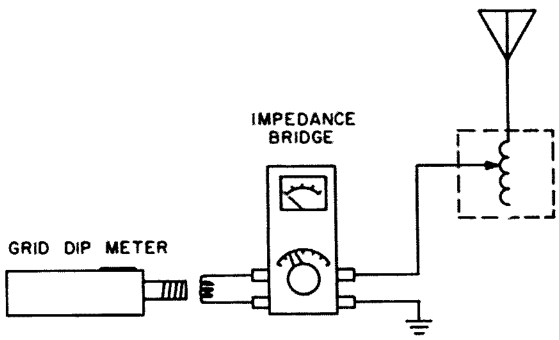


FIGURE 3

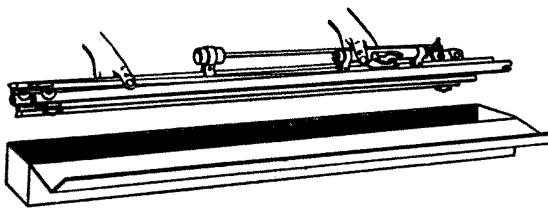
plane until a perfect mesh was made between the gears. The nut and bolt were then firmly tightened and to date (after hours of testing) have proved capable of support.

The system was then placed in the plastic food container for protection against the weather, and the bolts inserted through the large right angle, through the roller support, and terminated on the outside of the container. The result is an integrated unit ready for installation on the line, but only after a test run, for it is imperative that the two gears track well. This can be accomplished by bending the motor right angle support ever so slightly in order to accomplish proper working relationships.

The electrical connections are standard as per Fig. 3. The lead from the antenna is connected to one end of the coil (an arm is provided in the original equipment) and the coax fitting is connected to the roller. A length of cable provides the avenue for transmission of power.

With the variable inductor in place on its lofty perch, and protected within its plastic container, one need only plug in a 115 v line (connected to the motor) and watch his bridge. When the meter indicates a null, the plug is pulled from the socket and the radiating system is tuned to the desired frequency.

. . . WB2CQM



Hi-Par Hilltopper

This antenna has been around for quite a while now, but there is a good possibility that some of you VHF'ers may have missed seeing it. The main application for this antenna is for chaps who want to operate from a portable location on six meters. This is a three element Yagi beam, complete with a gamma match for 52 ohm coax, and it folds down into a very small package for carting around in the car or lugging on the back to mountain tops. It weighs only 3¾ pounds.

The Hilltopper is so small that I usually have it packed away in the back of the VW along with a Lafayette HE-45B, just in case any mountains happen to loom up during a trip. The other day, just for the heck of it, Virginia

and I zipped up to the top of Pack Monadnock and within three minutes I was on the air. Stations well over a hundred miles away were worked with fine reports.

The beam takes less than two minutes to assemble. All of the screws are tightened with wing-nuts, so you don't have to fight with a screw-driver. The elements fold along the boom and the boom comes apart in the middle so that the package goes down to only 40″ long, 3½″ x 4½″ square. The ends of the elements telescope in for folding.

Most rigs are designed to work with 52 ohm coax, so the built in gamma match solves a lot of problems that might be troublesome with the more common beams and their 300 ohm feed which would then have to be fed through a balun to the rig.

The Hilltopper was used exclusively during the June VHF QSO Party with the Clegg Thor and turned in a remarkable performance. 247 stations were contacted in 31 ARRL sections. When you consider that one of the most formidable six meter installations in the country also worked only 31 sections, using a kilowatt and a 64 element beam, the Hilltopper did amazingly well. Costs $11.95 from Hi-Par, Fitchburg, Mass.

Amplitude Modulation Quiz

Carl Drumeller W5EHC
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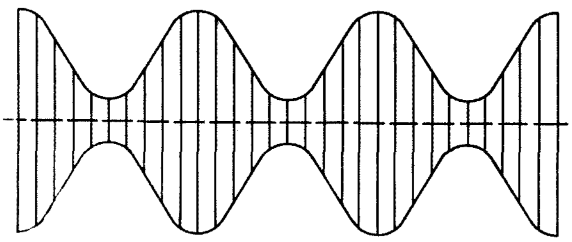
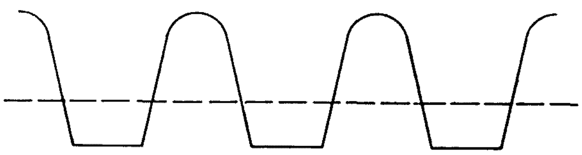
Oklahoma City 22, Oklahoma

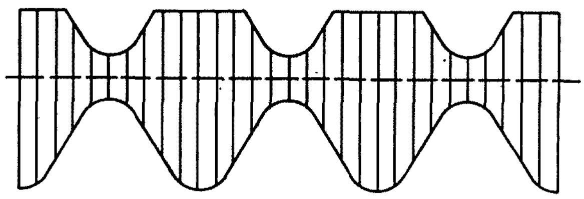
1. A sine wave fed into a modulator will cause the modulated RF envelope to resemble the following wave-form:



If the audio wave-form is not symmetrical but looks like this:



The modulated RF envelope then would look like this:



____ True
____ False

2. When a plate-modulated power amplifier is being modulated 100% by a sine wave, the instantaneous plate-to-cathode voltage, as read by an af (not rf) VTVM, will:
____ A. Remain constant if the stage is properly adjusted.
____ B. Vary from 1.414 times the plate supply voltage to 0.707 times the plate supply voltage.
____ C. Vary between zero and twice the plate supply voltage.

3. The instantaneous peak rf power output of a plate-modulated rf power amplifier being modulated 100% by a sine wave is:
____ A. Same as the average unmodulated power output.
____ B. Twice the average unmodulated power output.
____ C. Four times the average unmodulated power output.

4. "Sidebands" normally are present in the radiated output of every radiotelephone transmitter, even when the transmitter is properly adjusted and operated.
____ True
____ False

5. Production of harmonics of the normal rf operating frequency can be reduced by reducing the rf grid excitation to the modulated power amplifier. In view of this correct statement, the question is: "Can this be done to a plate-modulated rf power amplifier without causing its signal to occupy more than its normal share of the frequency spectrum?"
____ Yes
____ No

6. If the audio system of a radiotelephone transmitter is so operated as to cause the production of af harmonics within the audio system, this will cause the transmitter to produce rf harmonics.
____ True
____ False

7. The loss of one tube in a Class B push-pull audio modulator will cause the transmitter's rf envelope (as viewed on an oscilloscope) to appear non-symmetrical.
____ True
____ False

8. The loss of one tube in a Class B push-pull audio modulator will cause a reduction in the audio power produced by the modulator. In view of this true statement, the question is: "Will the total bandwidth of the radiated rf signal be greater than if both tubes were functioning normally?"
____ Yes
____ No

9. The dc milliammeter in the plate circuit of a plate-modulated rf power amplifier "wiggles" when the transmitter is modulated by a Class B modulator. Check each of the following items that you believe might cause an indication.
____ A. Too little rf grid excitation.
____ B. Too much rf grid excitation.
____ C. "Flat" tube in rf power amplifier (loss of cathode emission).
____ D. Over-modulation
____ E. Under-modulation.
____ F. Poor voltage regulation in the rf power amplifier power supply.

10. A conventional plate-modulated AM transmitter, with no phase modulation or frequency modulation present, sometimes will have more power in one sideband (upper or lower) than in the other sideband.
____ True
____ False

ANSWERS TO AMPLITUDE MODULATION QUIZ

1. The statement is false. Invariably, the lower half of the envelope of an amplitude-modulated rf wave-form will be a mirror-image of the upper half.
2. C. This is in accord with the explanation customarily given.

3. C. If, as in the conventional explanation of the process of plate modulation, it is assumed that the instantaneous plate-to-cathode voltage has been doubled at the positive peak of the audio modulating cycle, then the instantaneous plate current also will have been doubled. This, then, will cause the instantaneous peak power to be four times greater than the quiescent power.
4. This statement is, of course, true. Sidebands, an inevitable product of modulation, should never be confused with "splatter," a product of improper modulation.
5. The answer is no. To be plate-modulated, a stage must be operated Class C. This, among other things, means that it must have sufficient grid excitation to operate at full efficiency when the instantaneous plate voltage is double its normal value. All Class C stages deliver their rf power to the plate tank circuit in pulses. This, of course, predisposes toward the production of rf harmonics. This, in a well-designed transmitter, is minimized by the use of a tank circuit of proper Q. To drop the rf grid excitation sufficiently to make an appreciable improvement in the reduction of rf harmonics would require the stage to operate without sufficient rf drive to comply with the prerequisite. Therefore the rf output envelope would be "flattoped," causing the production of spurious frequencies far beyond the normal channel of legitimate sidebands.
6. This statement is false. There is no relationship between af harmonics in the audio systems and rf harmonics in the rf system.
7. This statement is false. As mentioned before, there always is symmetry between the upper and lower halves of the rf envelope from an amplitude-modulated transmitter.
8. The answer is yes. The loss of one tube in a Class B audio stage will cause the audio wave-form to be non-symmetrical, indicating the presence of harmonics. These harmonics will cause the width of sidebands ancillary to the radiated rf signal to be many times their normal width.
9. Choice A is correct. Too little rf drive will not permit the dc plate current to rise fully on the positive crest of the modulating af wave-form. It can, however, go down the full amount. The average value, therefore, will be less than the resting value; so the meter "wiggles" with modulation.
   Choice B is not correct. Too much grid excitation to a pentode or a tetrode tube can cause its total output to drop. This drop, however, would not be noticeable more on modulation peaks than at other times.
   Choice C is correct. If the tube in the modulated stage is lacking in total cathode emission, it will not be able to supply sufficient plate current to permit the plate current to rise fully during positive modulation crests.
   Choice D is correct. If the stage is operating in a husky Class C condition, the plate current can rise to more than twice its quiescent value on the positive modulation crests. It cannot, however, drop beyond zero on the negative modulation crests; therefore it will flicker during over-modulation.
   Choice E is not correct. Under conditions of less than 100% modulation, the plate dc current meter of a plate-modulated Class C rf power amplifier should remain static. Any movement may be taken as an indication of malfunctioning.
   Choice F is correct. This is a design problem, one that seldom is correctly solved in either amateur-built or commercially-built amateur transmitters.
10. This statement is false. An examination of the formula for an amplitude-modulated rf wave (available in any good electronic textbook) will show that the power in the upper sideband always is exactly equal to the power in the lower sideband.

Rotten CW*

**(with sincere apologies to the memory of T.O.M.)*

Alex Trembloy W1GQJ
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St. Johnsbury, Vermont

With the renewed interest in amateur radio telegraphy and the advent on the market of several automatic telegraph keys, (including mine), it would seem very apropos to review the practices of many of the CW fraternity. Some of these habits are incredible. A lid with a bug at ten words per minute will still be a lid at forty-five per with a fully automatic key as he sends dots at a seventy word rate and dashes at a thirty-five word rate, with six dots for "H". A small minority uphold the finest amateur radio traditions by setting a good example either by their silence, when called for, or by their adherence to near perfection when using the International Morse Code.

Reaching all the way back to a book published in 1917, we come up with the interesting fact that a dash is equal in time duration to one dot, one space and one dot. The space between characters (dots and dashes) is equal in time duration to one dot. The space between letters of the same word is equal in time duration to two dots (a dash). The space between words is equal in time duration to three dots (equal to A, N or S).

Now that we understand the makeup of perfect CW, let us analyze what is actually being sent on the Amateur bands. Here, we may pause and reflect on the plight of the handicapped. Some of this newly developed automatic code sending equipment should prove to be the "equalizer" that will help them in sending CW as well or better than the physically normal. Looking over any busy CW band, The Old Man (bless his memory) certainly would have complained about ROTTEN CW!

The complaint would be perfectly justified in the light of present day technology which has given us exotic (imagine!!) instruments to help us send perfect code.

Careful listening will turn up some interesting facts:

1. The letter H has three to twelve dots.
2. The letter S has two to five dots.
3. The letter C often comes out N N.
4. The word TEST sounds like NV; always!!
5. The word AND should always be sent: PD.
6. NAME should usually come out: NAG!!
7. The numeral 3 sounds like a Swedish call sign.
8. The first dash sent with a sideswiper should always be extra long and the last dash in any character should alway be cut off a bit short (Sounds like an idiotic pastime, already!)
9. A string of dots from a sideswiper should be either erratic or slurred. (7, 8 and 9 are supposed to make you sound like a real old-timer.)

Heaven forbid that all CW men should send exactly alike. The individuality shown is a good thing, BUT, gentlemen—dashes THREE dashes long; just because you once sent Land Morse for the railroad—wel-l-l . . . Those operators produced by radio club action quite often sound just like their teacher. When they finally get their own "ticket," they will all have the short dots, long dashes and triple spacing just like they heard it at the club.

A few of our so-called speed merchants also have some odd habits which may mislead listeners into thinking that RTTY is not necessary with these fellows around. In order to figure how fast these people are going, we will have to know at what rate per second dots and dashes should be sent in order to accomplish a certain "word per minute" rate. The answer is simply that the number of dashes per second, times five, equals the word per minute rate. An easier way is to look at the sweep second hand of a watch or clock and run dashes for five seconds while counting them. The number of dashes in that period is your "word per minute" rate providing you send at that rate for a full minute. The dots will have to be twice as numerous in the same period. Each word averages five letters.

One night recently, one station, with a near perfect first was pounding a bug at an eight dash per second speed for a "word per minute" rate of forty, and, in each minute managed to send 195 letters. Dividing this total by five gave 39 words per minute. Subtracting an error

and a repeated word, the net words was thirty-eight. Most operators would consider this quite an accomplishment. The other station, using a fully automatic key was doing twelve dashes per second for a word per minute rate of sixty while putting in some extra spacing. The total letters per minute came to 220 instead of the nearly 300 expected. Dividing this total by five gave a result of forty-four for each minute and subtracting four words in error, we came up with a total of only forty words for each minute. Considering all the noise that was being made on the frequency, it was reasonable to expect a lot of words go with it.

A few stations are the practitioners of an unusual habit. They apparently never extend their acquaintance beyond one, and at the most, two, other hams and always on the same band and same frequency. This is such an odd phenomenon in contrast to the familiar "hail and farewell" of a lot of operators, that it was decided to "read the mail." These two birds were only doing a rough twenty-five per, but they could have been sending in Chocktaw for all that was gained by listening. Their sending was so erratic that only by picking them up for a little while during several evenings was it finally possible to make out their call signs. Errors were made in nearly every word and about every third word was split in two and sent as part of the next word, presumably because the sender had to stop and figure how to spell it. The speed varied between extra long dashes and bursts of dots with short and long spacing. Evidently, these two understood only each other as they were never heard working any other station. Here was a horrible example of "rotten CW" at its worst. But, it had its good side in displaying for all to hear the liberties that can be enjoyed so long as they do not infringe on the liberties of others. Such "rotten" operating would undoubtly call for the FCC to decide that in view of the fact that its monitoring facilities could not understand what was being sent, it MUST be in code or cipher in violation of section 12.105 of the Amateur Radio Regulations. These people could then be rehabilitated and soon become outstanding operators at thirteen per in the International Morse Code.

While we are on the subject of the FCC, mention should be made of section 12.133 that has to do with purity and stability of emissions. Many hams have not heard of this, or if they have, the part that they particularly noticed is the one that says: "For the purposes of this section a spurious radiation is *any* radiation from a transmitter which is *outside* the frequency band of emission normal for the type of transmission employed, etc." To them, this must mean that any type of carrier with thumps, clicks, youps, musical saw effects, rattling marbles from bouncing relays, scratching from dirty contacts, backwaves forty kilocycles removed from carrier due to parasitics, etc., is OK so long as these "bonuses" remain within the boundaries of the band being used. One can only wonder if these lids will ever realize just how much noise they are making over and above that amount needed for reliable communication.

Back in the thirties, a real op felt definitely undressed unless he wore, while on the air, the latest model Dynatron frequency-meter-monitor. It must be that the monitor habit perished during WW2 as witness even some real oldtimers who go by the click in their "cans," asking; "Hw duz mi sig snd to u om?" Apparently, many never knew or have forgotten that a monitor was originally (and still is) a device with tuned circuits which picked up your signal OFF the air and let you know what it really sounded like. That small standby five tube receiver which has been collecting dust can now come into its own. With a very short antenna attached and usually with no antenna whatsoever, it becomes an excellent tuned CW monitor. Sliding off one can a bit, its speaker will let you know how your own rig is doing.

There is little doubt that a sidetone generator helps in sending better code, especially in conjunction with a fully automatic key. (This is so much fun that sometimes the spacing between words is left out.) The statement is made that the sidetone proves by its tape-like sound that good code is being sent. Sure! Sure, the sidetone sounds perfect but what does the actual transmitted signal sound like? "Soam. hw duz mi sig snd to u?"—"Your characters are perfectly formed, your spacing is out of (indeed) this world BUT you've got a backwave that sounds like the guy slamming the car door on a TV commercial."—Wonder how much of that showed up in the speaker of his sidetone generator. A real Radio Frequency Monitor, tuned or untuned, will not only help you send better code, but will also tell you what a lid you are until you clean up your signal. This last may be the main reason for the lack of monitoring facilities at those stations where the need is greatest.

Maximum utility can be realized by keying in one of the low power stages; preferably the oscillator or oscillator/first buffer. Automatic or fixed bias or a clamp tube become a "must" on the following stages, but the extra effort is well worthwhile considering the flexibility obtained. This brings up the question from many

hams who wonder why they get a "ee-youp" report when keying the oscillator. Many of them run a full gallon and they complain that their lights blink in time with the keying. Here is visible evidence that there is so much voltage drop on the ac side of the power supplies that not enough dc is supplied to the VR tubes to give them anything to regulate. As a consequence, the oscillator "ee-youps"! These boys need to know a lot about adequate wiring.

Differentius Keyitis is the prodigious name of an affliction borne by one who can be heard most any time adjusting (he claims) his keying characteristics. He also, must be without a monitor because he is always in doubt as to the quality of his signal. One of these has a voltage regulation problem plus a bouncing relay contact. It has often been hinted that he sounds like a musical saw with the "beat" like loose marbles in a paper bag. The musical ear must be lacking because the signal quality never improves. The real contemptible cad though, is the habitual vfo swisher who can never be identified except during a contest.

The fully automatics come in for their share of criticism as they adjust their monsters by making endless strings of dots and dashes on the Ham bands while performing these adjustments. The trick is to achieve perfection in the generation of pulses which eventually become dots and dashes. This search for the ultimate does set an example of some sort, but, it should be remembered that we are using this medium not for extreme accuracy for a shot around the moon, but for normal conversation and traffic handling.

This points up several facts absorbed during thirty years of hamming, plus fifteen years previously spent in various experiments. This included (while still in grammer school) the building and operating of a Model "T" Spark rig which used to put old KDKA, WGY etc., off the air locally until an alert constabulary feretted us out ! ! !

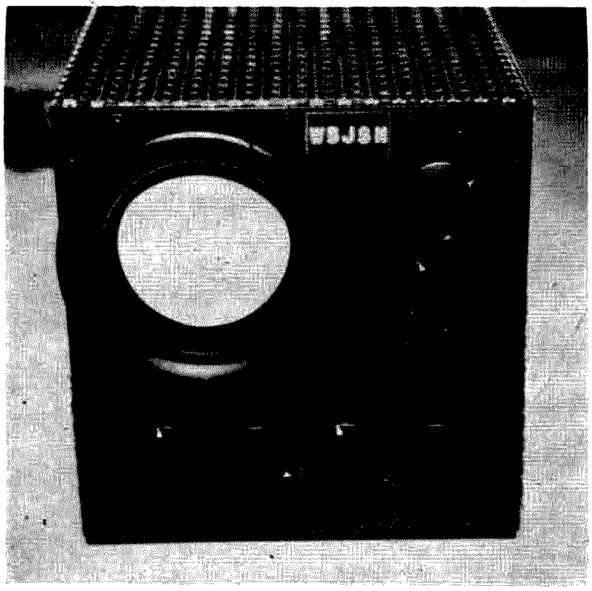
FACT 1. A poor note can not only be tolerated but actually enjoyed if from an old friend who has not been heard in a long time. He will be glad to know what his signal sounds like so he can apply corrective measures.

2. Good CW is extremely enjoyable if there is a very slight variation in character lengths, spacing, etc., indicating that a human is manipulating the key. This becomes even more interesting if the operator actually has something to say besides commenting on: the wx, band condx and rig hr is a blankit rng 15Z? ? ? 1H7 . . . 157 watts to a ---

3. Perfect code from a machine is an enduring joy to copy if the receiving end also consists of a machine.

4. Abbreviating the characters on your new automatic so as to sound fully automated will not get you too many ragchews. Try sounding like people again. You will be pleasantly surprised at the results.

5. While the technical prowess of a 'phone operator does not depend on the "DB's over S9" his receiver indicates; when using a key, all the way from the "hand pump" to the most exotic automatic, your CW is *YOU!*



Capt. John Sury W5JSN
139 Nebraska Rd.
Dyess AFB, Texas

Monitor Scope

Have you been thinking about building a monitor scope? This may be the project just for you. Not a whole lot of effort or pocket funds are needed. It sure is nice to monitor your own signal when transmitting as well as helping your fellow hams with their signal. The monitor will not take up much space in your shack because it only measures 5" high by 5" wide by 9½" deep. It could keep you from getting a notice from an "OO."

On transmissions the scope can monitor signals from 80 thru 2 meters. A choke of approximately 1 mh is employed in the input to the crt when transmitting on SSB on the 40, 20 and 15 meter bands and a plug in tuned circuit on 80, 40, 10, 6 and 2 meters. Hams who only work 15 and 20 do not need the tuned circuit. Using a Heath Seneca 6 and 2 a desirable wave shape was observed when modulating normally, but when hitting it hard the peaks were cut off as a result of over modulation. A beautiful trapezoid was observed on SSB. In receive a series of trapezoids were observer on SSB and a series of envelopes on AM. When using a plate modulated transmitter the modulation may be fed to the horizontal and the rf to the vertical. This has not been attempted by the author because he does not own a plate modulated transmitter.

The horizontal sweep generator is a sawtooth wave shape which is variable between 15 and 50 cps. A 30 cps sweep produces a clean trapezoid, envelope or carrier.

Let's get with the building by starting with the chassis. You can purchase a ready made 5 x 9½ x 2" aluminum chassis at your neighborhood electronics store. Drill and cut out all holes as indicated in the chassis layout. It sure can save you a lot of trouble because the author had quite a time trying to locate everything on this small chassis. Obtain some panel

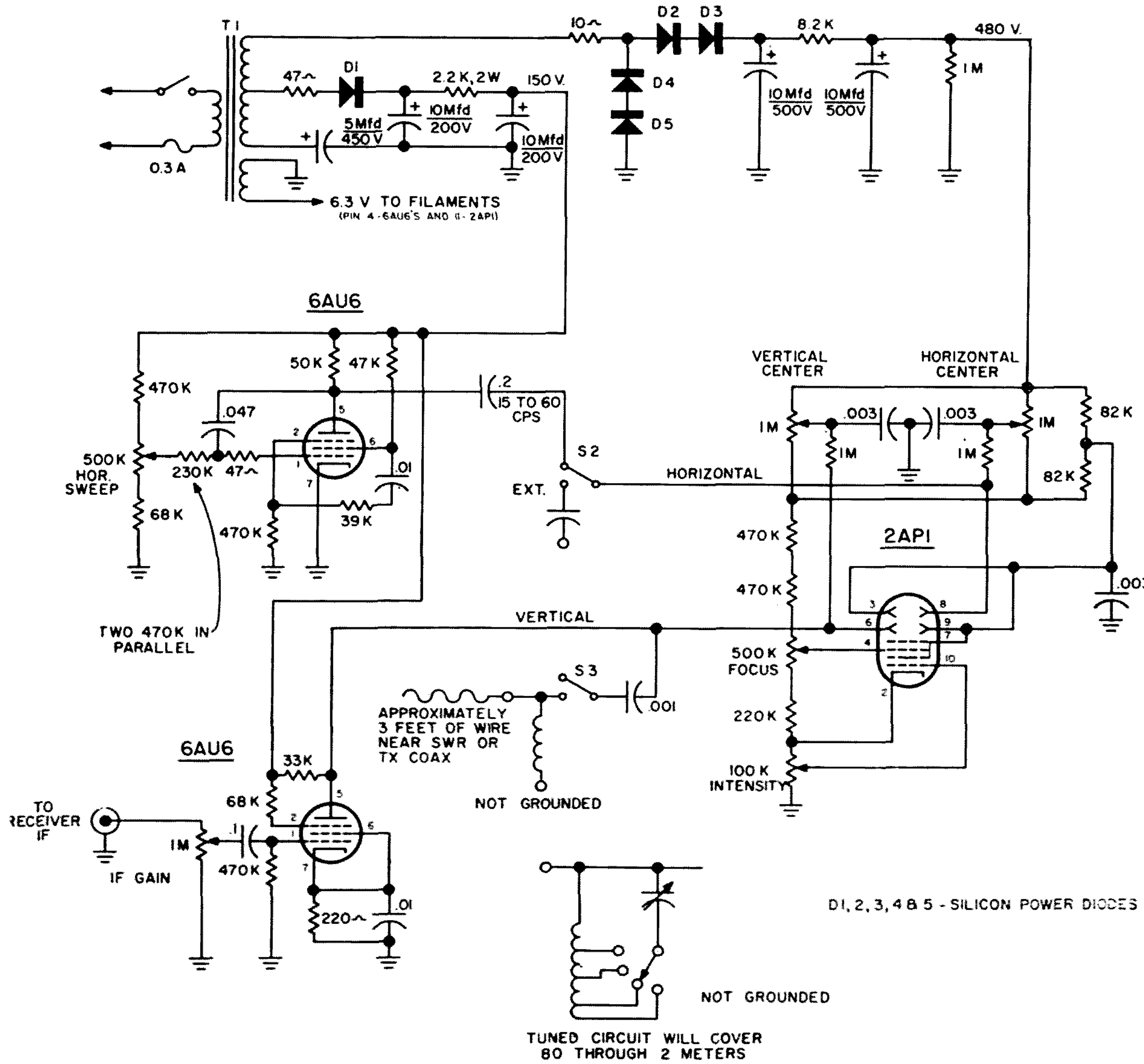
material, 1/16 to ⅛ inch thick aluminum, and cut out all holes as indicated. Lay aside the front and rear panels and install transformer, sockets and terminal strips. A bag of 25 assorted terminal strips may be purchased at an electronic supply house for less than a half of a dollar. In one of these bags you can find the ones just to fit your needs.

Power Supply

This is a low voltage supply as scopes go. A Knight transformer furnishers 125v each side of center tap at 25 ma and 6.3 volts at 1 amp. Even though the current for all tubes total 1.2 amp for filament, the scope has been left on for hours without ill effects or overheating. A voltage doubler is taken off one end of the secondary to give approximately 480v to the crt circuit while the low voltage is obtained from

the center tap. The crt has more than enough brightness and response. Bargain basement silicon power diodes are used for the power supply.

The CRT circuit is just the old standard circuit used on many scopes. A 2AP1 tube or equivalent is used. The 2API's were readily available at one time on the surplus market.



MONITOR SCOPE

FIGURE 1

Maybe you were fortunate to get hold of one.

Horizontal Sweep Generator

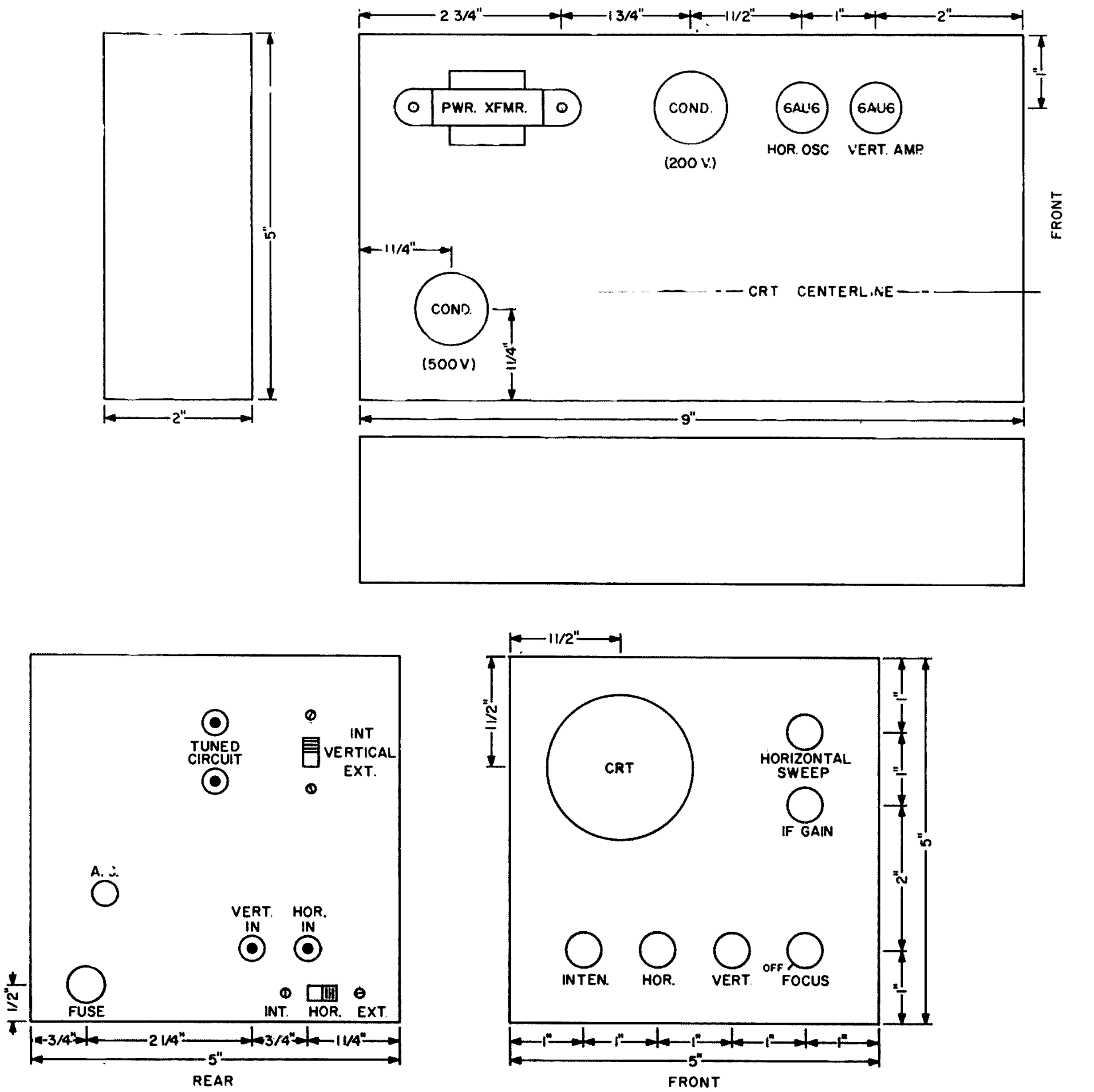
A 6AU6 pentode is employed in this circuit. The frequency is variable between 15 and 50 cps. It has an output of 16 volts which is ample enough to fill the 2API. To change frequency range increase or decrease C5. There is no critical wiring, just follow the schematic.

Vertical Amplifier

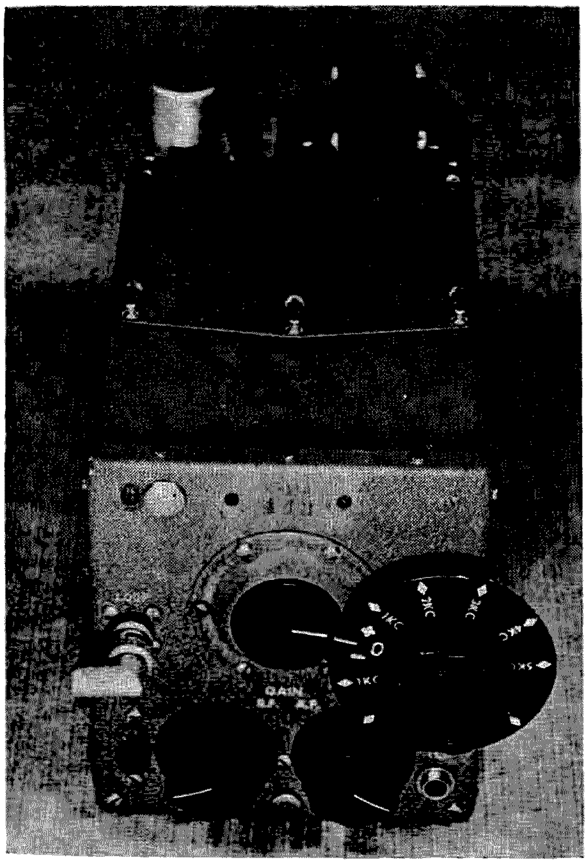
This circuit also uses a 6AU6 tube. The low current of the tube allows the builder to stay within limits of the power supply. The receiver signal is taken from the plate of the last *if* stage and coupled with a 25 to 100 uuf capacitor. The value does not seem to be critical. This should be a very simple modification to the receiver. The author used a Drake 2A receiver and there was more than enough vertical deflection from the last *if* tube.

Not much more can be said about the monitor scope. It is straight forward with surprising results. The author would like to thank W5SZN, Pete, of Dyess AFB and W5WNK, Smitty, of Sweetwater, Texas, for the donation of a 2AP1 tube and shield. It is possible that the project would not have been attempted if it were not for these two gentlemen. Good luck in your construction of the monitor scope. See you on the bands.

. . . W5JSN



SUGGESTED LAYOUT
FIGURE 2



The completed Q5-er conversion.

The Q-5er Reborn

Roy Pafenberg W4WKM
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Fairfax, Virginia

Photos by Morgan S. Gassman, Jr.

A late entry to the famous Command Set line-up is the Aircraft Radio Corporation Type 12 equipment. This is a commercial, light aircraft radio set consisting of a number of individual components that can be arranged to meet navigational, VHF and UHF requirements.

Certain of these postwar production, navigation and VHW radio components were adopted by the military services for light aircraft use. It should be noted that, while the equipment is commonly known as the ARC-12, this is a commercial designation and not the military nomenclature. Although not treated in this article, one grouping of this equipment provides two-way UHF communications. This equipment has been designated as the AN/ARC-60.

Since some of the items are entering the surplus market, they are worthy of amateur attention. The R-510/ARC and the R-511/ARC are likely to be available to the amateur in fair quantity. The VHF equipment is now available in small quantities but the light aircraft market will probably absorb most of the supply.

The ARC-12 equipment is beautifully constructed, using loctal tubes and circuitry which is improved over the BC-435—R-23/ARC prototypes. Changes required to adapt this unit to amateur use will be mentioned later. Physical construction is very similar to the earlier Command Set receivers. The rear chassis connector has been eliminated and all connectors appear on the front panel. No dial scale or dial drive is included on this series of receivers, although the conventional worm drive is provided for the tuning capacitor. Two antenna inputs are supplied. A low impedance loop input is terminated on a BNC coaxial fitting and the long wire antenna input is connected to a front panel binding post. An internal relay switches between the two inputs. The photographs show construction details of the unmodified R-511/ARC receiver.

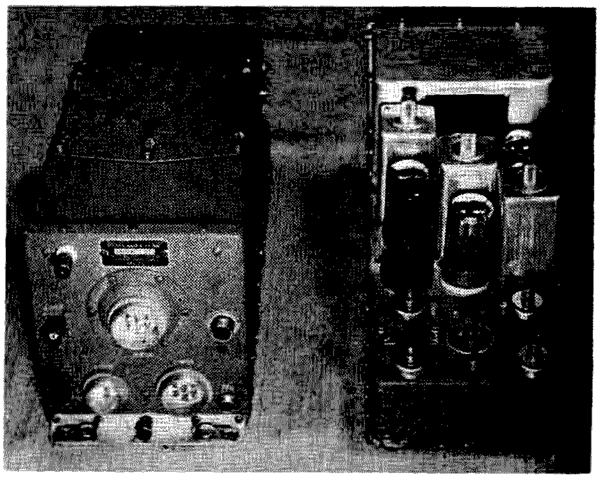
Aside from the limitations imposed by the lack of a bfo circuit, any of the standard Q5-er modifications are applicable to the receiver and good results may be expected. Conversion of these receivers follows the same pattern as for the more familiar Command Set receivers. A power supply must be constructed for operation from the 115 volt line and the dynamotor mounting plate provides a suitable chassis. Incidentally, the dynamotor mounting dimensions and connections are identical to those of the AN/ARC-5 dynamotor. The power connectors are removed from the front panel, audio and rf

gain controls are installed and a tuning knob and dial scale are provided.

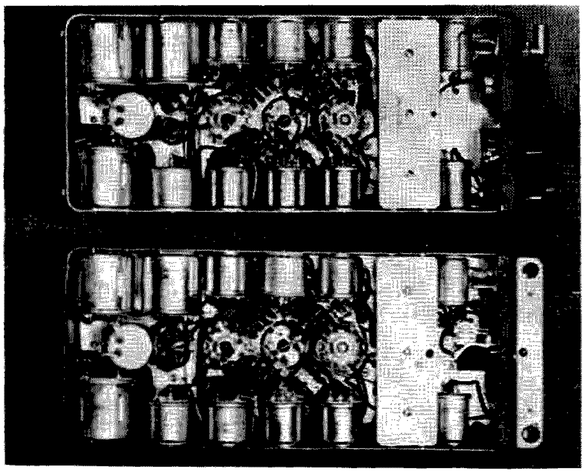
The ac power supply is constructed on the former dynamotor mounting plate and is installed in the same manner as the dynamotor. Construction of the power supply is greatly simplified and circuit changes minimized by use of a power transformer specifically designed for such applications. This transformer is available from Fair Radio Sales Company, 2133 Elida Road, Lima, Ohio. The transformer carries the part number 619 and sells for $3.95.

Remove the dynamotor from the plate, leaving the connector in place. The mounting centers of the transformer specified enabled it to be mounted using existing holes. Carefully drill out the rivets securing the retaining clips at one end of the plate and insert ½", 4-40 machine screws from the under side of the plate. Make a pile up of washers to the same shape and size as the defunct shoulder rivets and place over the screws. Solder 6" insulated leads to each contact of the ex-dynamotor connector and dress toward the other end of the plate. Place the transformer over the screws and secure one side, using a flat washer, lock washer and nut on each screw. Enlarge the two holes falling under the other two transformer mounting slots to accept #8 screws and dress the transformer leads toward the empty end of the plate. Insert ¾" 8-32 machine screws in these holes, install ¼" spacers between the plate and the transformer, and secure, using lock washers and nuts.

The balance of the power supply components are mounted on a 1¾" x 2⅝" aluminum plate. This sub-chassis is mounted on ¾" metal posts, using 3 existing holes enlarged to pass 6-32 machine screws. For the want of a better small connector, a miniature crystal socket is mounted on this plate to permit connection of the ac line switch leads. The 6 x 4 heater is operated from the 5 volt winding of the transformer and no ill effects have been noted as a result of the reduced voltage. The 100 ohm surge resistor, which is listed as a 2 watt unit is shown as a 10 watt wire wound resistor in the photograph. After components are mounted and clearances checked, the assembly may be wired as a standard full wave supply. The photographs show the details and no difficulty should be experienced. This power supply is, of course, equally applicable to either the SCR-274-N or the AN/ARC-5 receivers.



The R-511/ARC receiver before conversion.



The converted receiver is above, the unmodified unit below.

The actual modification of the receiver is next on the agenda. Remove the screws holding the bottom plate and the outer cover of the receiver. Remove the two front tubes and loosen the front *if* can to permit removal of the tuning capacitor shield. Set the covers and mounting hardware aside for future use. Remove the screws and ground post which secure the mounting bracket to the bottom of the front panel. Discard the angle bracket and the ground post, reinstalling the screws.

Clip the blue lead connected to the antenna binding post and fish it through the chassis. Remove and discard the binding post, filling the hole with a snap plug. Unsolder the blue lead, along with C-601 and R-601, from the ceramic insulator next to the antenna trimmer. Clip the other ends of these components from the lug on the trimmer capacitor and discard C-601 and R-601. Unsolder from the relay contact the gray lead which runs to the antenna connector, J-601 and connect this lead to the vacant terminal of the ceramic insulator. Remove the second gray lead which runs between a relay contact and pin 5 of L-601A, the antenna coil. Connect a 50 mmfd mica capacitor between pin 5 of L-601A and the insulator to which J-601 is terminated and solder this connection.

Remove and discard the two blue leads which run between the antenna trimmer and a relay contact and between pin 6 of L-610A and a relay contact. Remove the ceramic capacitor C-602, connected between pins 1 and 6 of L-601A and strap these two pins with a length of bare wire. This completes the antenna input circuit changes. The tuning capacitor cover may now be replaced, the *if* can be tightened down and the tubes inserted.

The next steps remove the front panel power connectors and the now unused antenna relay. Minor wiring changes are made to connect the heater and plate circuits directly to the dynamotor connector. Remove the metal extrusion which mounts J-606 to the center of the front panel. Clip all leads connected to J-606 and work them through the chassis clearance hole. Remove J-606 from the extrusion, discard the connector and mount the extrusion to the front panel, using the original hardware. Pull the two red leads free to where they terminate on C-634 and pin 1 of T-601. Clip these leads, discarding them, and connect a jumper between the terminals of C-633A and C-633B. This step connects the receiver B+ circuits directly to the dynamotor receptacle.

Clip, from pin B of J-602, the black lead which connects to the negative terminal of C-608 and solder this lead to the ground lug of the antenna trimmer. Clip, from the terminals of J-604, the black and brown leads formerly connected to J-606, the black lead which runs to pin C and the brown lead which runs to pin A of J-603. Remove and discard the white lead which runs between pin D of J-603 and one terminal of the filament choke, L-612. Remove one of the white leads from the other terminal of the choke and solder it to the vacated terminal. This removes the filament circuit from the front panel connectors and connects the low inductance choke in the filament circuit of the receiver. Clip the two green leads from pin E of J-603 and dress them aside for future connection to the rf gain control. This frees all wiring from J-602, J-603 and the antenna relay except for the leads which interconnect these components. Remove these parts and discard as a unit. All wiring in the receiver should be terminated except for the two green and one black leads which will connect to the rf gain control.

Drill out the spacer studs which were used to mount the antenna relay and the two center captive nuts at the bottom of the front panel. Cut a 1¾" x 3" aluminum filler plate and mount it inside the bottom of the front panel,

The ac power supply constructed on the original dynamotor plate is shown along with the dynamotor.

using machine screws through existing panel holes. Drill a ⅜" hole in the center of the mounting hole for J-602 and a second ⅜" hole the same distance in from the panel side and bottom in the J-603 mounting hole. Mount a 50,000 ohm, 2 watt control in the left hand hole and a 2 megohm, audio taper control with switch in the right hand hole. Ground one side of the 50K pot and connect the center tap to the ungrounded terminal of C-608, a 3 mfd capacitor. Remove the resistor (R625, 2 meg) and capacitor (C-636, 350 mmfd) connected to pin 5 of the 12A6. Connect a .005 mfd capacitor between the junction of a 150K resistor and 100 mmfd capacitor from which C-636 was just removed and one side of the 2 meg pot. Ground the other side of the pot and connect the center terminal to pin 5 of the 12A6. Use a defunct crystal holder as the power supply connector for the ac switch leads.

The above work completes the basic modification of the receiver. All that remains is the installation of a suitable dial, control knobs and decals. The tuning knob which fits the splined capacitor drive shaft is identical to that required for the older Command Sets and it has always been in short supply. Fair Radio Sales Company of Lima, Ohio stocks these knobs and the price of $1.00, while high, is in line with the scarcity of the item. The type of dial or dial scale required will depend on the proposed application of the receiver.

In the conventional Q5-er application, the highly selective Command Set receiver is coupled to the last *if* stage of the less selective normal station receiver. The Q5-er is tuned to the center of the station receiver *if* bandpass and tuning accomplished in the usual fashion. In this mode of operation, an uncalibrated knob is all that is required. Alternatively, the normal receiver may be set roughly to the desired frequency and tuning accomplished by sweeping the Q5-er across the *if* bandpass of the normal receiver. In this instance, the Q5-er is required to tune only a few kilocycles. Since one revolution of the Command Set capacitor drive shaft tunes the receiver approximately 13 kc in the vicinity of 450 kc, a scale may be fitted to the tuning knob and directly calibrated in kilocycles above and below the center frequency of the normal receiver *if* bandpass.

The latter method is used in the converted receiver shown in the photographs. The spinner disk of a standard Command Set knob is removed by drilling out the peened over brass shaft and soldering on a 1" extension made from a hollow, brass standoff post. A 2 ¾" diameter dial plate is removed from a standard knob with scale assembly and given a coat of

black lacquer, reassembled, mounted on the new shaft and the unit installed, using the original locking nut. A 1⅛" snap hole plug is given a coat of black lacquer and installed in the now vacant J-606 connector hole. An index line is marked on the hole plug, as shown in the photograph, and calibration is accomplished as described later. Knobs are now installed on the audio and rf gain controls. The 1½" skirts of the knobs shown cover the former connector holes nicely. This completes the conversion and the unit is now ready for test and calibration.

Install the new power supply in the same manner as the original dynamotor and plug in the connector which terminates the ac switch leads. Connect ac power, plug in a pair of phones and advance the audio and rf gain controls. The tubes should light and, after a few seconds, background hiss should be heard in the phones. Connect an antenna and tune across the band. Aircraft range and ship stations should be heard with good volume. Unscrew the caps from the *if* transformers and pull the fiber rods out as far as they will come without forcing. This reduces the coupling of the windings, reducing the bandwidth substantially. Stations should still be heard, at a bit less volume but with greatly improved selectivity. If all checks out OK, install the top cover and the bottom plate and the job is finished.

To connect the Q5-er to the receiver, strip the outer jacket and shield from one end of a length of RG-58/U cable and wrap a couple of turns of the insulated center conductor around the plate lead of the last *if* stage of the station receiver. Install a BNC plug on the other end of the coax and connect to the antenna receptacle of the Q5-er receiver. Couple a signal generator or, better still, a frequency meter into the normal receiver and center the signal in the *if* bandpass by tuning for maximum signal. Tune in the *if* signal on the Q5-er and scribe the "0" calibration point on the tuning knob Offset the signal generator 5 kc above and 5 kc below this frequency and, without tuning the normal receiver, tune the Q5-er for maximum output and scribe both points on the tuning knob scale. Divide the dial scale between "0" and the 5 kc points into five equal sections and mark the individual kilocycle calibration points. Commercial decals may now be applied and a very practical dial results.

Other refinements which may be added and which will enhance the utility of the converted receiver include a bfo circuit, avc disable switch and a self-contained speaker. The latter subject is treated in detail in the article, "Command Set Speakers" which was published in the January, 1962 issue of 73*Magazine*. Many articles have been published on the Command Set receivers and much of this material is directly applicable to the ARC-12 equipment. The references given barely scratch the surface. A comprehensive bibliography of all surplus conversion articles published since the war is now available from 73 *Magazine*.

While the ARC-12 equipment will never be as plentiful as the older Command Sets, their utility is as great. The up-dated circuitry, better wiring and improved components make them more desirable and worth the premium price they will command.

. . . W4WKM

Aircraft Radio Corporation Type 12 Equipment Components

R-507/ARC, R-19 (14 v): VHF, AM receiver, 118 to 148 mc, continuous tuning; 14 vdc power requirement with self-contained dynamotor. Modern 9 tube superheterodyne circuit with 2 rf and 3 if stages, agc, noise limiter and 360 mw audio output into 300 ohms. Sensitivity is better than 2 microvolts for 10 mw output. Selectivity is 175 kc at 60 db down. Unit is very similar to Command Set receivers in appearance except no dial scale is provided and all connectors terminate on the front panel. Rf gain control is external to the set and no audio gain control is provided.

R-508/ARC, R-19 (28 v): Identical to R-507/-ARC except power requirement is 28 vdc.

R-509/ARC, R-15 (28 v): Identical to R-507/-ARC except power requirement is 28 vdc and frequency coverage is 108 to 135 mc.

R-510/ARC, R-11A (14 v): Lf-mf, AM receiver, 190 to 550 kc, continuous tuning; 14 vdc power requirement with self-contained dynamotor. Receiver uses octal and loctal tubes and features 1 rf and 2 if stages, agc, noise limiter with 800 mw output into 300 ohm load. Sensitivity is better than 2 microvolts for 10 mw audio output. Selectivity is better than 35 db down at 3 kc off resonance and 60 db down at 5 kc off resonance. Unit is very similar to the BC-453 Q5-er except that no dial scale is provided and all connectors terminate on the front panel. No bfo or audio gain control is provided and rf gain control is external.

R-511/ARC, R-11A (28 v): Identical to R-510/ARC except power requirement is 28 vdc.

T-363/ARC, T-13 (28 v): VHF, AM transmitter; 5 crystal controlled frequencies in any 2 mc segment of the 132 to 148 mc band. Range may be lowered to 125 to 132 mc by the use of a special capacity plate. Power is supplied by the dynamotor of the companion receiver through a front panel connector. Transmitter uses 4 6AQ5 or 5763 tubes for a power output of 2 watts into a 50 ohm load. Panel size and construction is similar to the receivers of this series. The case is shortened by the width of the dynamotor which is not used in the intended application.

T-364/ARC, T-13 (14 v): Identical to the T-363/ARC except relay and heater circuits are wired for 14 vdc operation.

T-336/ARC, T-11 (28 v): Identical to the T-363/ARC except frequency coverage is 116 to 132 mc and relay and heater circuits are wired for 14 vdc operation.

T-366/ARC, T-11 (28 v): Identical to the T-363/ARC except frequency coverage is 116 to 132 mc.

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Save that Mil

Donald Hall K1JWU
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While the home station usually enjoys almost unlimited current available for gear, mobileers operate comparatively high power with definitely limited power sources. Obviously, any savings that can be effected, no matter how small, will benefit in increased battery and generator life and can easily make the difference between a start and no start.

Various cars differ in their electrical set-up so no exact procedures or recommendations can be given; but your own system should be studied carefully and advantage taken of every little current saver you can find. For instance, if the car is so wired that the front parking lights remain on with the headlights, a separate or different switch can be installed to cut them off when the headlights are on. A savings of 3 or 4 amps can often be effected this way. Instrument and dash lights also need checking. If they can only be dimmer, or are turned off by increasing dimmer control resistance, another switch can be installed to isolate them when not needed. Another few mils saved. If the parking and tail lights are of overly high wattage, they can be changed for lower wattage bulbs (consistent with State regulations and safety, of course) and the same applies to direction indicators and stop lights.

One point to keep in mind, though, if you change the wattage of your flashing turn signals; the flashing unit itself is designed to work with a given load and its rate may be affected by a drop in load. Don't add a resistor to bring it back up—change the flasher unit itself for one designed for the wattage you intend using. And —do you really need all the dial lights on your rig at all times? Would one bulb do where two are now? A separate switch, perhaps? There could be a few extra mils there, you know.

How about the general condition of the electrical system? Most of us take great pains to insure the battery, regulator and generator are all up to snuff and that there are no fuse-blowing shorts; but what about the rest of the wiring system? The entire car should be checked and every current-consuming device given close scrutiny. (Yes, even those wires you have to crawl under the car to find!) Deteriorated insulation on wires, high resistance grounds, bad connections and high resistance shorts can all consume many valuable amps without visible effect—and they all add to the total current drain and leave just that much less available where it's needed.

Arm yourself with a sensitive low-range VOM and check resistance to ground at each device; it should be zero. Any reading here will indicate valuable current being used to heat lamp sockets and connections. Check voltage drop by measuring first at the battery terminals and then at each device (with the device turned on, of course); more than a few tenths of a volt, while acceptable on the normal car, is just too much to waste with a mobile rig. And you may be surprised to find as much as 2 or even 3 volts difference. If you do, it indicates that new and larger wires or switches are in order.

Assume nothing and take nothing for granted until you have personally checked it. That flashy, bechromed light unit can often hide poor workmanship, poor connections and high resistance shorts. And need anything be said about the effects of moisture and corrosion? Generous blobs of anti-corrosion grease (petroleum jelly in a pinch) in the right places can make a world of difference.

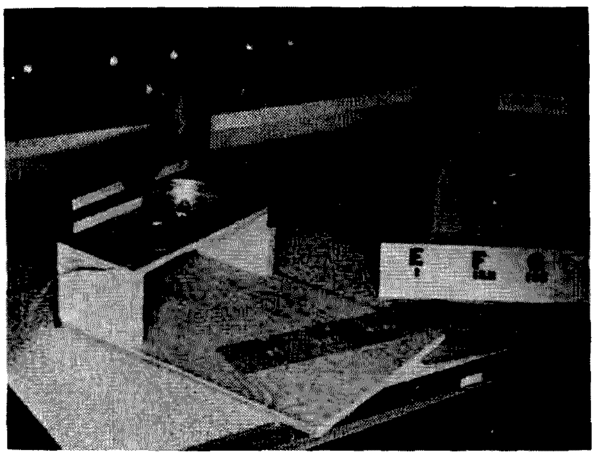
There is no short-cut method and you cannot assume that just because the car is new and expensive everything is in apple pie order. A few greasy hours spent with VOM, screwdriver, and pliers will pay dividends in peace of mind, more reliable starting, better overall efficiency and—bonus of all bonuses—a possible "S" unit jump on the other fellow's receiver with those few saved mils applied to your plate!

. . . K1JWU

Cliff Waters K6OKX
3921 Markridge Road
La Crescenta, California

Code Master

Here's a gadget you can build for less than a dollar and a couple of spare hours that will teach you code quickly and efficiently.



"I'd like to be a ham, but I can't pass the code test." This cry from a multitude of potential good ham and SWL operators prompted project code master.

The code hump is around eight words a minute. Code Master will start you from scratch and take you over the hump in a few short weeks.

Learning code by the dot-dash memory method is slow and tedious. Code Master lets you hear the exact keyed musical tone and shows you visually what the character is you are hearing; no di and dah to remember; hence a direct conversion from code to character.

Drag your portable record player out of the closet and measure the depth (top of the turn table to bottom of case in playing position). This is a key dimension to start construction. Fill this dimension in on the sketch.

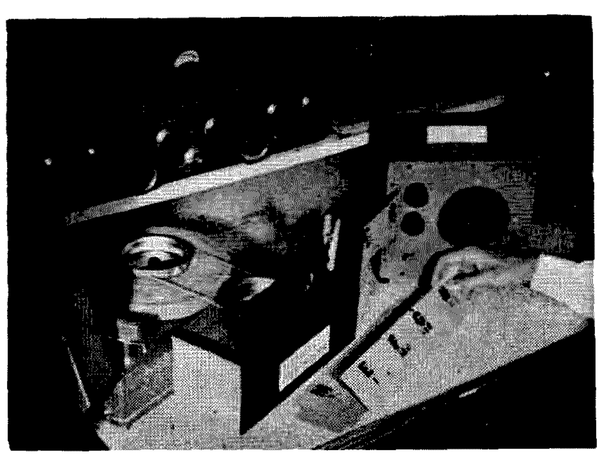
Search the trash box for a couple of screw-on jar lids (instant coffffee or peanut butter lids work fine) approximately 3½" ri. x ⅝" deep. Drill a ¼" diameter hole in the center of each. Cut a piece of coarse sandpaper to diameter of one lid and cement it to the outside bottom (sand side out) of one lid. Place this lid over the center spindle of the turntable and secure with a tight fitting rubber grommet. This forms the drive pulley for your code masteh.

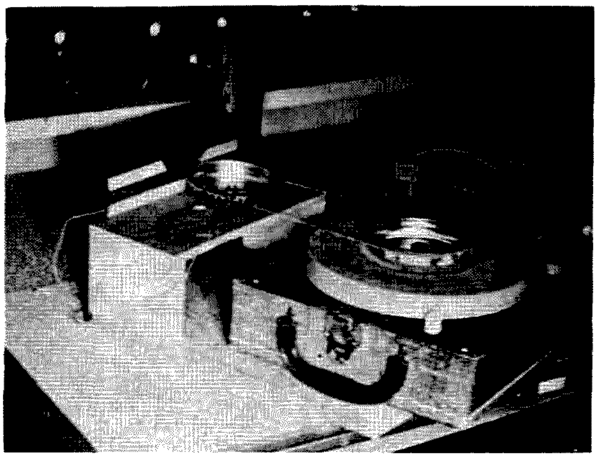
Refer to the sketch and cut a base, spacer blocks (2) and a bearing support from ⅝" plywood. Cut a piece of ⅛" thick masonite for the front panel to size as shown. Bore a 1" diameter hole for the window in which the coded character will appear.

Drill a ⅜" diameter hole thru the 4" x 10" piece of plywood as shown. Note this hole is offset 1" from the hole in the front panel. Sand the edges of all parts smooth and nail together.

Dig into the junk box for a ¼" shaft panel bearing or the threaded bushing from a discarded potentiometer. Cut two pieces of insulated hook-up wire (20 or 24 gage) about 2 feet long. Strip the insulation back 1½" on one and twist it securely under the head of the panel bearing for a good electrical connection. Insert the shank of the bushing thru the ⅜" diameter hole and secure with a nut on the underside. The other end of the wire connects to one side of the audio oscillator key circuit.

Cement a piece of aluminum foil (the bottom of a TV dinner tray is better) 5" long,





centered in the area below (back side) the window in the front panel. Use a paper clip to secure the end of the second wire to the foil plate. This wire goes to the opposite side of the audio oscillator key circuit.

The second lid forms the keying switch for the code master. Punch two small holes ½" apart at the lip edge of the lid. Insert a piece of light gage music wire thru the holes leaving 2½" protruding to the left (see sketch). Solder the wire in place for a good mechanical and electrical connection.

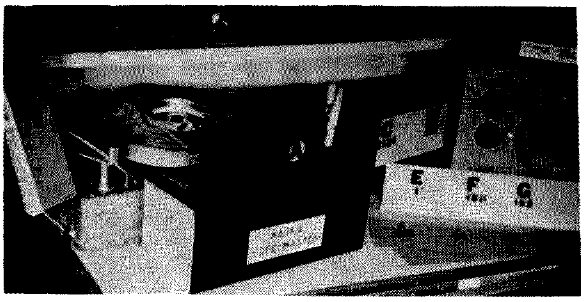
Next, to mount the keying switch. Install a ¼" x 1½" long hex head bolt from the bottom side of the panel bearing; secure it with a nut on the top side. Do not tighten the nut as the bolt must turn freely in the bearing.

Install the lid with the wire projecting to the left. Secure with a lock washer and nut. Check again to make sure the bolt turns freely in the bearing. This completes the mechanical construction of your code master.

Place the record player in position on the mounting base and note the distance between the lid drive wheels. Daisy chain some light rubber bands together to form a drive belt.

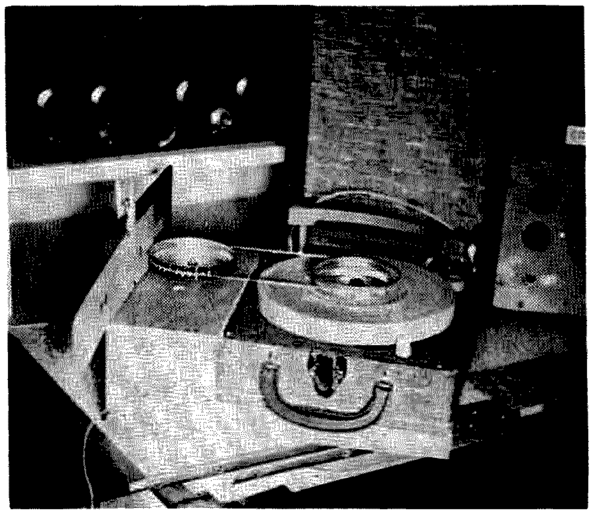
Turn on the record player to see if the contact wheel is operating freely.

The code keying stencils are cut from light cardboard. The author found that two for a nickle manila file folders worked perfectly. They are stiff andslick enough to give good wear. Cut the folder into strips 2½" wide x 11½" long. Keep the cut edges square. Divide the length of the strip into four equal sections



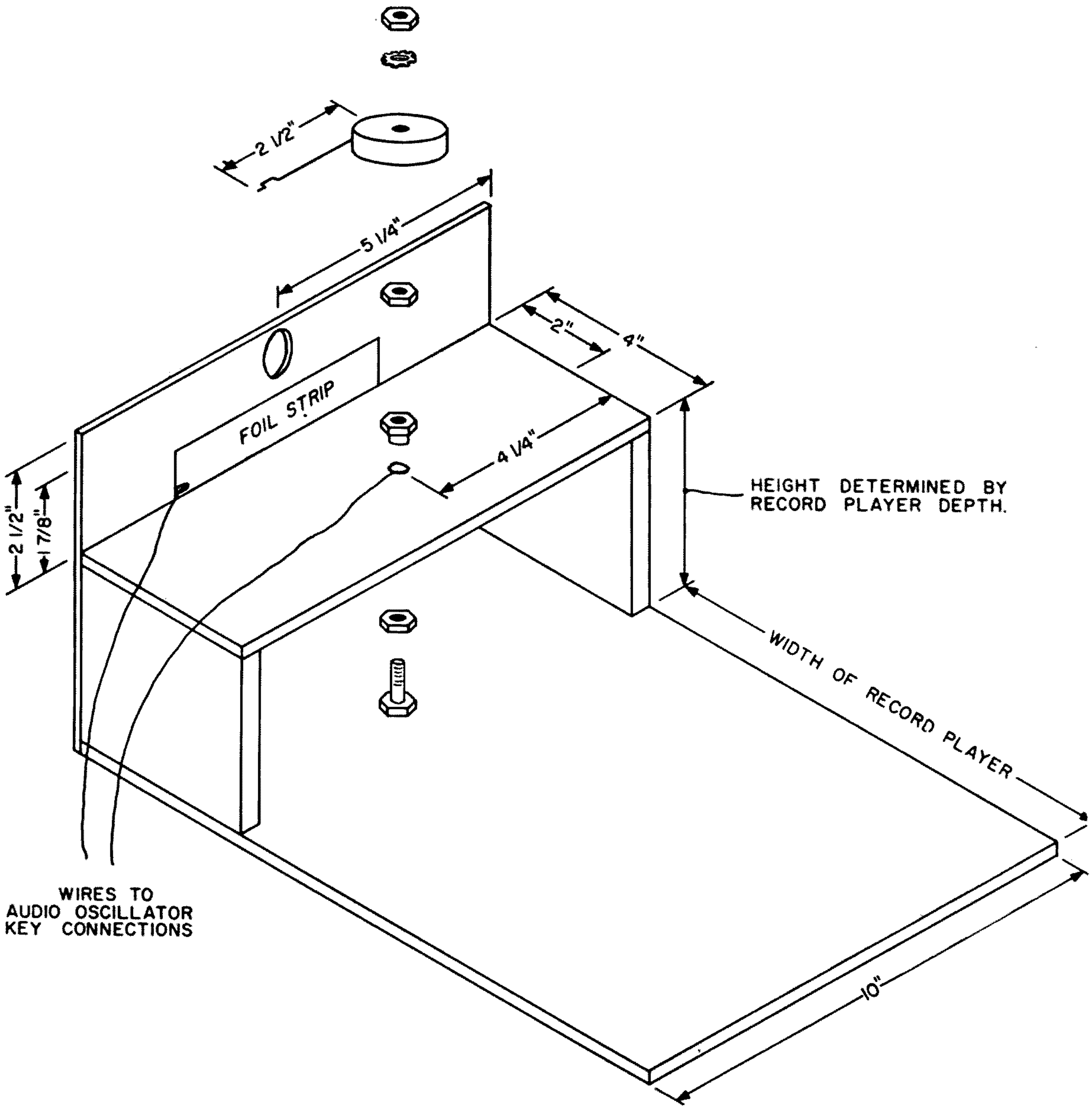
with a light pencil line. Hold the strip behind the 1" diameter window in the front panel, allowing it to rest on the bearing base. Place the strip in a manner that the center of one marked off section is centered in the window. Use the window as a template and inscribe a penciled circle on each of the four sections of the card.

Hand letter or cut large letters and numbers from magazines and paste on in each circle. Each card now has four characters which form



the visual part of code master.

Place the card behind the window and mark where the wire on the contact wheel strikes the



card. This is where the audio code stencil must be cut under each letter.

Cut the cardboard away ⅛" wide for dots and spaces ¼" wide for dashes. Make the openings ½" long. Note that the contact wheel moves in a clockwise motion so the code stencil must be cut backwards, i. e. "A" is normally . —; it should appear — . on the stencil.

Place a stencil in the code master, holding it in place with a spring clip clothes pin. Turn on the audio oscillator and record player. Sit back and listen to the firm fist Code Master sends you. Associate the character in the window with a tone you hear. In a few days you'll copy code with perfection. The record player speed changer allows you to copy as fast as you like. 33 1/3 RPM equals 6 words per minute; 45 RPM equals 10 words per minute and 78 RPM equals 15 words per minute.

Good luck! We'll be looking for your CW on the ham bands.

. . . K6OKX

Diode Interference

Small power diodes are sometimes an unsuspected source of radio frequency interference.

A small broadcast/FM set was plagued with bad RFI—birdies and spurious rough signals. It was being operated within a mile of a 5 kw broadcast station. It was operated from a bridge of silicon power rectifiers. A .01 disc cap paralleled with each of the four rectifiers cleaned up the RFI.

The local broadcast station was being heard in the ham shack on every one of its harmonics. The trouble was traced to a bridge of silicon rectifiers feeding the antenna rotator. Again a .01 bypass across each of the rectifiers did the job.

A stubborn case of TVI was traced to nonlinear rectification of the transmitter's normally clean signal in a bridge of 24 volt silicon rectifiers operating a T-R relay. The .01 bypass cured it.

It is apparent that all power silicon rectifiers should be bypassed for rf if they are likely to be subjected to a strong rf field. It is easy for these rectifiers to be driven into the nonlinear portion of their characteristics and act as frequency multipliers. Rf voltage picked up on the power lines can easily get to these rectifiers if they are not properly isolated and cause RFI that may be very confusing.

. . . W6JAT

12 Volt Conversion of the Communicator II

Charles Green W31KH
17 Little Lane
Levittown, Pa.

It was the same old story; after having spent considerable time building and buying equipment for the car, I had to trade the car in. Then came more time in converting the six volt equipment over to twelve volts.

I have always enjoyed two meter mobile with my Gonset Communicator II, but since it was built for 117 vac and 6 vdc, mobile operation was limited to the length of a long ac line cord.

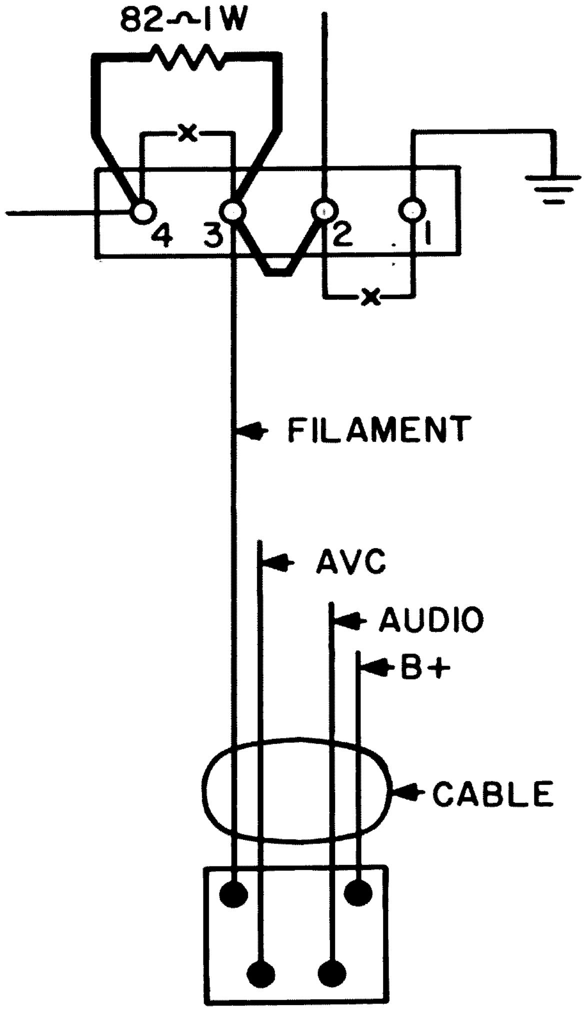
The Communicator II is built with three chassis, a receiver, transmitter and power supply. The power supply chassis is supplied in either six or 12 volt dc versions. (Both with 117 vac also). The receiver and transmitter chassis are wired in a series parallel filament hookup, allowing either six or twelve volt operation by changing terminal strip jumpers.

The main problem in converting the Communicator II to twelve volts was the power supply chassis. A new power transformer, vibrator and rectifier tubes would be needed.

This conversion was not as simple as could be desired, but having no other choice, I decided to go ahead with it anyway.

A commercial equivalent of the original power transformer is the Merit P-2858. This transformer fitted the physical measurements and its electrical ratings are close enough to be utilized. Also, it would fit into the original transformer's mounting holes.

The original transformer was then removed and the Merit P-2858 was then installed. The original vibrator was replaced by a 12 volt



TO TRANSMITTER CHASSIS

FIGURE 1

type and the 6 x 4's were replaced by 12 x 4's. This did not involve any rewiring.

It was found that the B+ output voltage was higher than that required by the Communicator II, so a filter choke from the junk box, and a resistor in parallel with it (LI, R1) was added to bring the output B+ voltage to the required 300 volts. Any other type of filter choke, with the right resistor in parallel can be used as well.

LI is mounted on top of the chassis in front of the rectifier tubes and R1 is mounted under the power supply chassis by a long machine screw.

The filament jumper connections on the receiver chassis are changed as in Fig. 1. The 82 ohm resistor is added, as directed by the instruction manual, to balance the filament string for 12 volt operation. The heavy lines indicate additions and the x-x-x lines indicate removals of wiring.

Fig. 2 indicates the jumper connections to the transmitter chassis. This schematic shows how the filament string is changed from 6 to 12 volt operation.

This conversion has been used by both myself and on K3BBE's Communicator II with good results in both mobile and ac line operation. The only thing that has caused some concern is that the filament circuit requires approximately 2.5 amps while the transformer is rated at 2 amps. But this has not affected operation in any way and the transformer does not seem to be running hot.

Now I'm all set for mobile operation indefinitely, unless the new cars switch over to 24 volt wiring.

. . . W31KH

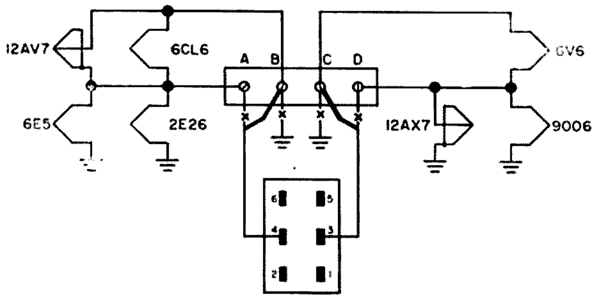


FIGURE 2

Parts List

T1—Power transformer, 12 vdc, 117 vac primaries. 330 vdc 100 ma hv secondary. 12 vac 2 amp secondary. Merit P-2858
VIB.—12 vdc vibrator. RADIART S-4, Base diag. A. or equiv.
L1—12 henry, 30 ma, 450 ohm, filter choke. UTC-R-15 or equiv.
R1—650 ohms, 10 watt, wirewound
12X4 rectifier tube—(2 ea.)
82 ohm, 1 watt, carbon resistor
Note—Any combination value of L1 and R1 that will reduce the output B+ voltage to 300 volts can be used (see text).

73 Tests

Now that Tapetone (Telco) has switched to commercial gear there has been a void in the high quality ham VHF gear department. Thus we were particularly interested when a new company turned up with converters and preamplifiers for the six and two meter bands and made haste to obtain a sample and check it out.

The unit selected was a two meter nuvistor converter. The unit is so low priced ($34.25) that we didn't expect a lot. When the converter arrived we looked it over carefully and were quite surprised at the amount of effort and design that had obviously been put into it. The layout was first rate and by any VHF standards and the construction beautiful. The low price no doubt dictated the economical painted grey finish and the rubber stamped panel markings, but we're after performance, not beauty.

And performance we got. I had been using my old 417A Tapetone converter as a standard and was shaken to find that all was not well. Theoretically the nuvistor job should be able to come close to the Tapetone, but shouldn't be able to actually beat it. It did, and by a wide margin. Hmmm. Back to the lab to see what happened to the Tapetone.

The Amplidyne converter comes tuned for optimum performance on the lower half of the band, where the activity is. Should you desire to use it in the upper reaches you can easily retune it.

Amplidyne has a small matching power supply available ($9.75), complete with power plug. Since I like to change converters around now and then, I sort of wish that they'd used the same power plug as all the others. Amplidyne is to be congratulated on turning out a nice little converter at an exceptionally reasonable price.

Alco Power Supply

Every now and then a need arises for a low voltage power supply to run a transistor radio or converter. We needed such a gadget and decided on trying the $19.95 unit sold by Also. This transistorized variable voltage supply provides from 0-20 volts (read on built-in meter) at either 20 ma or 200 ma (also read on meter). This supply also can be useful in test work where you need a small positive or negative voltage (bias, avc, etc.) and in charging small batteries. Darned handy.

Belgium Rally

Sept. 22

Special licenses can be had for operation in Belgium from Sep. 14th to 30th for participation in the Red Cross Centenary Radio Rally on 2M and 80M phone. Write Rene Vanmuysen ON4VY, 81 Rue J. Baus, Wezembeek-Oppen, Bt., Belgium, giving names, addresses, calls of all ops, car license, dates in Belgium, photo copy of your ham license, power and freqs of your mobile rig covers. If you are going to be around on Sep. 15th you may want to try a fox hunt in Brussels. For details on this direction finding contest write V. Claeys ON4UM, 68 Rue Haute, Beersel, Brabant, Belgium. If you would like a Dutch license for the same period send the same info to N.A.S. Fitch G3FPK, 79 Murchison Rd., Leyton, London E 10, England.

Short Items, but Interesting

Second Op

Some of the newer DX'ers may not be familiar with W9IOP's "Second OP" slide chart. They should be. For one dollar "Electro-Voice, Buchanan, Michigan, will mail you this gadget which will save you a lot of time in looking things up in the Callbook.

The slide-chart has all of the countries listed by call letters prefix and gives you the location, zone, country, great circle bearing, time differential and postage rates as you dial. The chart also has the QSL Bureaus listed, which can be handy.

Electro-Voice has just brought the chart up-to-date on both countries and postage, so send for one f these Second Ops and keep it on the operating desk to help you in DX'ing and QSL'ing.

Club Subscriptions

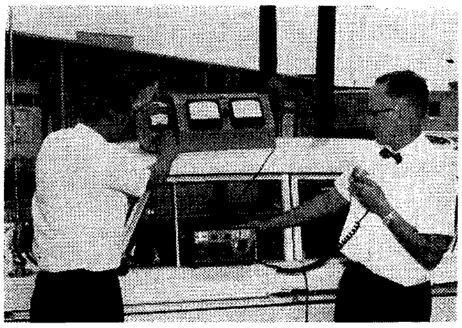
At the next club meeting we would appreciate it if you would call our group subscription rate to the attention of the members. In groups of five or more simultaneous subscriptions (or renewals) the rate is $3.00 per year until our coming subscription rate increase (shortly). Please be sure to send five or more at once, include calls and QTH's and issue we should start the sub with.

Mobile Clinic

One of the biggest problems with mobile operation is getting that antenna tuned up right. New-Tronics is doing something about the problem: mobile clinics wherein test equipment is brought out to check the power output of transmitters and the match of the antenna. This is a service to hams that would do well to be spread.

These clinics are being conducted by John Altmayer K8UQV, New-Tronics President and Fred Ohman W8FAT, Electronics Sales Manager.

John K8UQV, H. E. Ruble W8PTF of SREPCO and Fred W8FAT look over a well tuned car at SREPCO in Dayton where several hundred hams attended the clinic.



Fred W8FAT checks output of new Drake TR14 transceiver for Clem Wolford W8ENH using a Waters Dummy (no offense) Load Wattmeter.

Before you become a Silent Key

Carole Hoover K9AMD

According to the old saying, there are just two things you can count on: death and taxes. Settling up with Uncle Sam may be a must every April 15, but a fellow usually isn't forced to ponder his date with the Grim Reaper—and many don't. Ever!

Admittedly, it may sound morbid to suggest thinking seriously about joining the Silent Key list, but it's time something was said. Too often, a ham magazine carries the sad story of an ill-advised widow who sold her OM's deluxe station for a song. Every year, thousands of dollars are lost to needy wives and children who simply don't know what their relatives have invested in amateur radio equipment. And they're really not to blame.

There's probably not a ham on the air who hasn't pulled a sneaky trick to get a transmitter, receiver, or other accessory into the house without an uproar. Have you ever heard of a guy telling the little woman that his new rig cost about half the actual price? Or of a purchase made half by check and half by cash to keep the XYL from raising Cain about it? Sure you have. And in many ham shacks, equipment catalogs are carefully concealed to keep the folks or the lady of the house from throwing cold water on a dream station or antenna system.

The only way to help your wife or parents avoid a real skinning should you pound at the pearly gates before expected is to put some prices and values in black and white. A complete inventory of equipment kept up to date and filed among personal papers is a simple solution. One Midwest ham prepares labels giving model number, purchase cost, and suggested selling price and sticks it to each piece of equipment. This plan proves helpful for swapping purposes at any time.

Another suggestion is to gather the family and have a down-to-brass-tacks discussion of how to get the most out of equipment. Many electronic firms mail fliers listing surplus gear and current selling prices. And if a wife knows the right firm to contact, she can get the facts and figures to use as a guide. An only-ham-in-town should make certain his wife has the name and address of a trusted friend, also licensed, who could assist her in the disposal of equipment at fair prices.

Life begins at 40, somebody said, and you may be able to cut the mustard at 100; but just in case you should make a wrong turn during an orbital flight or decide to pull a Rip Van Winkle, why not assure your family of the returns they should have from your investments.

. . . K9AMD

General Coverage with the Collins S Line Receivers

Ray Moore K1DBR

The Collins 75S-1 and 75S-3 hamband receivers will tune a large segment of the high-frequency bands outside the amateur bands with no alterations of any kind. They will tune 15.033 mc to 15.433 mc which includes almost all the 19 meter broadcast band and 11.-533 mc to 12.133 mc, with a 100 kc gap, which is most of the 25 meter broadcast band, as well as the 8.923 mc to 9.323 mc band. No extra crystals are required.

This is possible because the preselector (rf and mixer) tuning is not ganged to the vfo in the "S" line receivers. It works like this, taking band 3C as an example. This band covers 14.8 to 15 mc using a 8.9775 mc crystal in the first oscillator. The first *if* has a bandpass of 2.955 mc to 3.155 mc. Using the second harmonic of the crystal we get 17.955 − 2.955 = 15.000 mc and 17.955 − 3.155 = 14.800 mc. Performing the same arithmetic using the fundamental of the crystal except that we must use the sum of the frequencies (explained later) we get 8.9775 + 2.955 = 11. 9325 mc and 8.9775 + 3.155 = 12.1325 mc. A look at the preselector tuning curves in the instruction manual tells us that the preselector will tune 11.933 mc to

12.133 mc at about 4½ on the scale with the bandswitch on the "C" range.

The reason we had to take the sum of the frequencies in the example above is that the different frequencies give a range of 5.833 mc to 6.023 mc which is outside the preselector tuning range for band C. When using the sum frequencies the tuning is backwards but the 1 kc per division tuning rate is maintained so it isn't at all difficult to interpolate any dial reading. On band D it is possible to use both the sum and difference frequencies of the fundamental.

The table lists the frequencies which can be tuned using this method.

... K1DBR

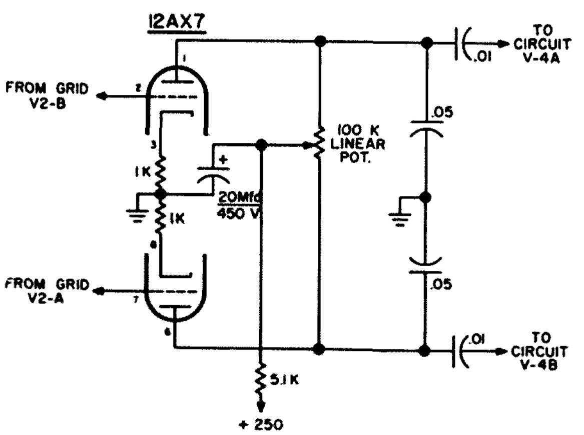
Band	Preselector Setting	Main Tuning Dial 0	50	100	150	200
3D	4½	15.433	15,383	15.333	15.283	15.233
2D	4½	15.333	15.283	15.233	15.183	15.133
1D	4½	15.233	15.183	15.133	15.083	15.033
3D	1	9.123	9.173	9.223	9.273	9.323
2D	1	9.023	9.073	9.123	9.173	9.223
1D	1	8.923	8.973	9.023	9.073	9.123
3C	4½	12.133	12.083	12.033	11.983	11.933
2C	4½	11.833	11.783	11.733	11.683	11.633
1C	4½	11.733	11.683	11.633	11.583	11.533
1E	1¾	12.673	12.723	12.773	12.823	12.873

Improving the W2JAV RTTY Converter

After building the W2JAV radioteletype converter I could not see too much advantage in using the T. W. Groger, W7HJC, brain child in the circuits of tubes V3 and V4.

Finally the two 47K-ohm resistors in the plate circuits of V3A and V3B were changed over to a single 100K-ohm linear pot. After once adjusting this pot along with R-1, the 50K ohm balance control, the brain child of W7HJC started doing its proper job. Now I can copy RTTY signals that I thought were impossible.

. . . K4GRY



IMPROVING THE W2JAV RADIOTELETYPE CONVERTER
SEE PAGE 43 OF APRIL, 1958 "CQ"

(W2NSD from page 6)

raise any strenuous objections to our filling this obvious void.

Perhaps in a few months we will be able to get our Area Coordinators together and evolve a more formal organization. In the interim I am going to act as Interim Secretary and start the ball rolling. By the time you have read this a letter will have been sent to all Institute members explaining this project and asking for volunteers who are willing to invest some of their hamming time and perhaps even some postage and phone money in acting as Area Coordinators or Division Directrs. I've asked them to send in a short resumé of their ham and personal background. I'll send out a copy of these resumés to all of the Institute members in each area so they can vote for the men they think will do the best job for them as Coordinator and Division Directors. It seems to me that we will be a lot better off to have all of the members voting for their officers rather than having a set of Directors electing their own choice for officers, which could end us up with officers seeing to it that the Directors are voted in which will perpetuate them in office . . . a round robin which we've already seen and don't want to duplicate.

Membership in the Institute is $1 per year. How about *you*, will *you* help?

Boo Boo

There was much to-do last month when we managed to print the issue before a major error was discovered in the Linear Systems ad. The prices on their two inverters are remarkable enough without their being transposed. The 150 watt model (12 volts dc to 120 volts at 60 cycles) is small and light enough to mount just about anywhere in the car. I've always mounted an inverter in my cars so that when I want to run a small rig, tape recorder, public address system, etc., all I have to do is plug it in. 150 watts will handle most gear easily.

Europe

The Institute trip to Europe is in fine shape. We've about 75 coming along. A list of the members of the trip is available for the price of a self addressed stamped envelope, complete with a short biography of most of the tourers.

We leave Idlewild October 6th in the evening, fly to London for four days . . . then Paris, Geneva, Rome, Berlin and back to New York on the 28th. The round trip fare, for anyone interested in joining us, is $550. This includes all transportation, hotels and breakfasts.

Hello CQ

The July issue of CQ finally dedraggled itself in here the other day. Come on CQ, you can do better than that! Since a great many of 73's readers no longer bother with CQ I'll give you a short rundown on this issue.

After piecing together the torn shreds of cover I found that they were busy celebrating

the RSGB's 50th anniversary. If your copy arrived without a shredded cover you didn't miss anything. I sure wish they would spend the fraction of a cent necessary to mail it in a wrapper. Inside I found at least six articles that seemed awfully familiar . . . aha! . . . I'm sure that at least five of 'em have been here first and been rejected. The sixth was a reprint from a year old copy of the now defunct VHF Amateur, though not labeled as such. The editorial opposed the ARRL proposal for Techs to have the entire two meter band.

This did it to me. In June they backed up the ARRL's disasterous proposal to segregate our phone bands and this month they come out in opposition to Techs on all of two meters, a not unreasonable proposal. There is nothing like being out of step *all* the time.

The present system of having two separate two meter bands is a hardship on all operators. It unnecessarily discriminates against the Technician during contests when a good deal of the activity is going on down at the forbidden low end. The level of QRM is low enough so there is no advantage to the enforced spreading out of stations, it just makes it that much more difficult to tune the band. Let's open 144-148 to the Techs.

. . . Wayne

73 PRODUCTS

73 parts kits

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER PREAMPLIFIER. Uses two 6CW4 nuvistors in a grounded grid input circuit (March '63 p8) and one 6CW4 nuvistor grounded grid output. Complete with power supply. Uses 50 volts on the plates for extraordinary noise figure. Full scale drilling template supplied.
W9DUT-1 .... $18.50

QRP TRANSMITTER. Have fun with this little one half watt CW rig on 40 meters. Uses any 40M surplus crystal. Kit supplies 1S4 tube and socket, condensers, resistors, coil, rf choke, terminal trip, etc. Runs from flashlight battery for filament and portable radio 67½ volt B-battery. See March '63 p22
W1MEL $6.00

15-20 METER NUVISTOR PREAMPLIFIER. Need more hop on these bands? This simple to build preamp will bring up those signals. This is particularly good for inexpensive and surplus receivers. See April '63 page 40
W6SFM-1 .... $4.00

TRANSISTOR POWER SUPPLY. Voltage regulater adjustable power supply for running transistor equipment. Takes the strain off those transistor batteries. Great for the test bench. See April '63 page 8. Uses five ransistors, one zener, cute little (expensive) meter, etc. Will deliver up to 100 ma continuously, voltage from 0.35 to 15.0.
W1ISI $25.00

TRANSISTOR TRANSCEIVER. One of the most popular kits we've ever assembled is this six meter miniscule transistorized transceiver. Really works. Hundreds built. See page 8 in the May '63 issue. Five transistors.
K3NHI $25.00

CW MONITOR. Connects right across your key and gives you a tone for monitoring your bug. Page 44, June '63.
WA2WFW $4.25

TWOER MODIFICATION. Increase your selectivity considerably by installing a new triode 7587 nuvistor stage. This is our best selling kit to date. Everything you need for the modification is included. See June '63 page 56
K6JCN $6.50

SIX METER CONVERTER, DELUXE. 6EW6 low noise front end, 6U8 oscillator and mixer. Output is 10.7 mc (easy to change to suit your needs). This is a tunable converter with fixed frequency output, not the usual converter that requires you to tune the receiver. This helps considerably on eliminating interference from nearby high power stations. See page 8, July '63.
W6DUT-2 ....$20.00

TUNING EYE KIT. This kit enables you to install a dual tuning eye in any transmitter to indicate the tuning of two or more stages. It works far better than a meter or even meter switching. See page 22, July '63.
K6GKU $7.50

NOISE GENERATOR. *Invaluable test instrument for tuning up rf stages, converters, etc.,* voltage regulated by a ener diode. Kit includes even the battery and mini-box.
K9ONT $5.00

73 News. Published monthly, editor VE3DQX. Keeps you up-to-date on current ham events. In valuable to club officials for discussions at club meetings. Good source material for club bulletins. 1.00/year.

Ham-RTTY. This is the most complet book on the subject. Written for the beginning TT'er as well as the expert. More complete and authoriative than books at twice the price. Pictures and descriptions of all popular machines, where to get them, how much, etc. $2.00

Bound Volume 1. Gorgeously bound library volume (bright red) of the first fifteen issues of 73. This is the only way to get a complete set of the early issues of 73. We'll pay $1 each for copies of the January 1961 issue in good condition so we can make a few more bound volumes. Covers October 1960 through December 1961. $15.00

Bound Volume 2. Complete matching volume covering 1962 issues of 73. $15.00

Binders. Bright red leather binding. Specify which year you want stamped on them: 60-1, 62, 63. Darbs. $3.00 each.

Back Issues. Since each issue of 73 features articles of a fairly timeless nature each back issue is just as much fun reading as the current issues. All back issues except January 1961 (we'll pay a dollar for these if you can find any) are on hand, some in mighty small quantities. 1960 issues $1.00 each.
February 1961-date 50¢ each.

Care and Feeding of Ham Clubs—K9AMD. Carole did a thorough research job on over a hundred ham clubs to find out what aspects went to make them successful and what seemed to lead to their demise. This book tells all and will be invaluable to all club officers or anyone interested in forming a successful ham club. Hundreds of grateful letters have been received from clubs who have applied the ideas in this book. $1.00

Simplified Math for the Hamshack—K8LFI. This is the simplest and easiest to fathem explanation of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc. If our schools ever got wind of this amazing method of understanding basic math our kids would have a lot less trouble. 50¢

Index to Surplus—W4WKM. This is a complete list of every article ever published on the conversion of surplus equipment. Gives a brief rundown on the article and source. $1.50

Ham-TV—WØKYQ. Covers the basics of ham-TV, complete with how to get on the air for under $50. Not the usual theory manual, but a how-to-do-it book. $3.00

Surplus TV Schematics. You can save a lot of building time in TV if you take advantage of the real bargains available in surplus. This book gives the circuit diagrams and info on the popularly available surplus TV gear. $1.00

AN/ARC-2 Conversion. This transceiver sells in the surplus market for from $40 to $50 and is easily converted into a fine little ham transceiver. Covers 29 mc (160-80-75-40 meters). This booklet gives you the complete schematic and detailed conversion instructions. $1.00

AN/VRC-2 Conversion. Completely different from the ARC-2. This book gives you complete instructions on converting the inexpensive VRC surplus gear into a six meter wide band FM transceiver. There are probably over a thousand stations now operating on 52.525 mc around the country. Join the crowd. Fun. $1.00

Coils—K8BYN. Basic book which covers the theory and practical aspects of the many different types of coils found in ham work. Well illustrated. 50¢

CW—W6SFM. Anyone can learn the code. This book, by an expert, lays in a good foundation for later high speed CW ability. 50¢

3D Map of World. Maybe you've been eating your heart out for one of these beautiful relief maps after seeing one at a friend's shack. Comes complete with one year subscription or extension to 73. $9.95

3D Map of U. S. Complete with one year sub to 73. $9.95

Mickey Miker—WØOPA. Complete instructions for building a simple precision capacity tester. Illustrated. 50¢

Frequency Measuring—WØHKF. Ever want to set yourself up to measure frequency right down to the gnat's eyebrow? An expert lets you in on all of the secrets. Join Bob high up on the list of Frequency Measuring Test winners. $1.00

Impedance Bridge. Full scale construction prints for the bridge described in the August 1961 issue of 73. Comes complete with a reprint of the article. Watch out General Radio! $1.00

SSB Transceiver Schematic—W6BUV. Giant size schematic of the transceiver that appeared in the November 1961 issue of 73. Complete with extra November issue. $1.00

Radio Bookshop

Read Books and Prevent Incentive Licensing

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. **$12.00**

11—16TH EDITION RADIO HANDBOOK—by Bill Orr W6SAI. This fantastic book is loaded with the most understandable theory course now available in our hobby plus dozens of great construction projects. This is the best ham handbook in print by a wide margin. Easily worth twice the price. **$9.50**

13—REFERENCE DATA FOR RADIO ENGINEERS. Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. **$6.00**

16—HAM REGISTER—Lewis (W3VKD). Thumbnail sketches of 10,000 of the active and well known hams on the air today. This is the Who's Who of ham radio. Fascinating reading. Only edition. Now only **$2.50**

18—SO YOU WANT TO BE A HAM—Hertzberg (W2DJJ). Second edition. Good introduction to the hobby. Has photos and brief descriptions of almost every commercially available transmitter and receiver, plus accessories. Lavishly illustrated and readable.. **$2.95**

21—VHF HANDBOOK—Johnson (W6-QKI). Types of VHF propogation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. **$2.95**

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, to install it, how to tune it. **$2.70**

23—NOVICE & TECHNICIAN HANDBOOK—Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license and build a station. **$2.85**

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. **$2.85**

26—S9 SIGNALS—Orr (W6SAI). A manual of practical detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. **$1.00**

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two tones might work. There are some fairly sophisticated filters available these days. We are open for articles along this line.

Slow Scan Television

The FCC apparently has finally come through with the slow scan tv permission. We'll have the exact frequency allocations by and by. This rule change has been hanging fire for about seven years now. Opponents to the proposal grumble that the slow scan signals are horribly wide and make a mess in the phone bands. Proponents point out all the things we can do with slow scan. We shall see more of both sides.

We have a couple of slow scan articles in the works here and will publish them as soon as we can. We are interested in more. Andre of Vanguard Labs has an idea that you might like to play around with . . . he is working on a system that will use a regular tv camera and monitor. Then you would record the signal on a drum and slow down the drum for radio transmission. The signals would record on another drum at the other end and this would speed up and the picture could be seen on the monitor. Instead of using a slow phosphor viewing tube you would just repeat the same picture over and over.

At any rate, slow scan is here so let's see what we can do with it. Let's try to cause as little QRM with the signals as we can and see what kind of interesting systems we can work out. It wasn't very many years ago that there were a lot of laughs when I proposed a WAS certificate for RTTY. Now it is time for one for television!

Your Advanced Class License

Our series on the Advanced License Study Course is winding up this fall. If you've followed the series you should have no trouble at all in getting your ticket and keeping most of your allocations. We will continue on with a study guide for the Extra Class and, I suspect, eventually go back and provide you with a course for the General Ticket.

Many of our readers write to tell us that the course is being used with great effectiveness by their clubs, with an hour or so devoted to questions and answers at the beginning of each club meeting based upon the current text. When the series is done we will bring the whole thing out in a separate book which can be kept at hand for future club courses. . . . Wayne

WTW Report

Since the last report, conventions and hamfests have caused QRM and we missed the last issue of the magazine. We now have a good system lined up, so my service to all of you will be speedier and more efficient. Remember . . . send all reports directly to me. Don't send anything to 73 Magazine. I have all the certificates here and am sending them directly.

We still need a good club in W/K1, W/K2, and W/KØ, as well as Africa for WTW card check points.

There seems to be some confusion about phone certificates. SSB and AM are both phone, and count toward the award for either mode.

Regarding Don Miller's cards . . . we are only accepting the ones that ARRL accepts toward DXCC, thus no one can say we make our rules as we go along. We accept as a country any spot recognized by any national radio society. If ARRL accepts, we do too. If RSGB accepts it we do too, Send 25¢ to get a copy of the country list/tally sheet. This will relieve any doubts you might have.

There are strong rumors that a number of fellows are getting close to WTW-300 on 20 now. I wonder who will be first to qualify? Check your cards very carefully as we look them over with a critical eye and will disqualify any which show they have been tampered with.

To make the task of anyone checking your cards for the awards easier, I strongly suggest, when possible, to have all QSO information on one side of the card, along with your call sign in fairly large letters. Next time you have QSLs printed, how about keeping this in mind? The business of flipping cards over and over when checking them can become a chore and requires twice the time.

Remember, to qualify for WTW, all contacts must have taken place after May 1, 1966.

The following stations have qualified for WTW since the last listing:

WTW-200, 14 MHz Phone:

Certificate #11, K8YBU
12, PY3BXW
13, W6MEM

WTW-100, 14 MHz Phone:
54, K5TGJ
55, K4VKW
56, SVØWL

WTW-100 21 MHz Phone:
13, W6MEM
14, K4VKW
15, WA1EUV

WTW-100, 21 MHz CW:
5, WØRRS

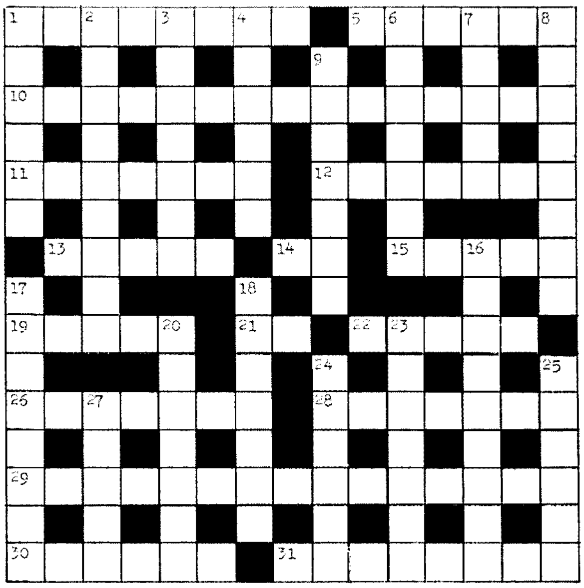
WTW-100, 14 MHz CW:
15, K4CEB

21 MHz Phone still has only W4OPM with #1, and 28 MHz both Phone and CW still await someone to pick up #1.

As soon as enough scores are received, I will start a running list of the number of countries various fellows have worked. . . . W4BPD

CROSSWORD
by

Michael Kresila
Box 57
Marion, Ohio 43302



Across

1. An amplifying station used to boost the volume on long telephone lines.
5. Noise heard in a receiver due to atmospheric disturbances.
10. The lack of dilution of a hue by white.
11. Flyback.
12. An electrode used to initiate conduction at the desired points in each cycle.
13. Undesired sound.
14. Aluminum. (Abbr.)
15. To make merry.
19. A series of names, numbers and words.
21. A world-governing body. (Abbr.)
22. The centimeter-gram-second electromagnetic unit of a magnetic induction.
26. Also called piggy-back control.
28. Trade name for a phenolic compound having good insulating qualities.
29. Use of radio signals for course-plotting.
30. To push with sudden force.
31. An electrode whose primary function is to reverse the direction of an electron stream.

Down

1. To preserve for later reproduction.
2. A high-vacuum thermionic tube used to control the magnitude of current flow. (Pl.)
3. Also called antennas.
4. An ionized layer in the atmosphere, about 55 to 85 miles above the earth's surface.
6. Representation of an operating system by computers and its associated equipment and personnel.
7. The rotation of a cross-section of a waveguide about the longitudinal axis.
8. The parts of a digital computer which carry out instructions in proper sequence.
9. Capable of being heard.
16. The transmitted portion of the suppressed sideband.
17. A dielectric that retains a charge after the charging field is removed.
18. A metallic alloy having special magnetic properties.
20. Fixed set of plates in a variable capacitor.
23. Slang expression for radio broadcasting.
24. A position of authority or trust.
25. A refinement added to an impedance bridge to avoid the effects of capacitance to ground.
27. A device, also known as acoustic radar.

Solution Pg. 106

Solution To Puzzle on Pg. 118

1 R	E	2 P	E	3 A	T	4 E	R	■	5 S	6 T	A	7 T	I	8 C
E	■	I	■	E	■	L	■	9 A	■	R	■	W	■	O
10 C	O	L	O	R	S	A	T	U	R	A	T	I	O	N
O	■	O	■	I	■	Y	■	D	■	I	■	S	■	T
11 R	E	T	R	A	C	E	■	12 I	G	N	I	T	O	R
D	■	R	■	L	■	R	■	B	■	E	■	■	■	O
■	13 N	O	I	S	E	■	14 A	L	■	15 R	E	16 V	E	L
17 E	■	N	■	■	■	18 M	■	E	■	■	■	E	■	S
19 L	I	S	T	20 S	■	21 U	N	■	22 G	23 A	U	S	S	■
E	■	■	■	T	■	M	■	24 O	■	I	■	T	■	25 W
26 C	A	27 S	C	A	D	E	■	28 F	O	R	M	I	C	A
T	■	O	■	T	■	T	■	F	■	W	■	G	■	G
29 R	A	D	I	O	N	A	V	I	G	A	T	I	O	N
E	■	A	■	R	■	L	■	C	■	V	■	A	■	E
30 T	H	R	U	S	T	■	31 R	E	P	E	L	L	E	R

YOUR CALL

Please check your address label and make sure that it is correct. In cases where no call letters has been furnished we have had to make one up. If you find that your label has an EE3*&* on it that means we don't know your call and would appreciate having it.

Propagation Chart

September 1968

ISSUED JUNE 1

J. H. Nelson

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14A	14	14	7	7	7	7	14B	14	14	14	14
ARGENTINA	21	14A	14	14	7A	14	21A	21A	21A	21A	21A	21
AUSTRALIA	21	14	14	7A	7A	7	7B	14	14	14	21	21A
CANAL ZONE	21	14	14	14	7A	7	14A	21	21	21A	21A	21A
ENGLAND	7A	7	7	7	7	14	21A	21	21	21	14A	14
HAWAII	21	14	14	7A	7	7	7A	7B	14A	21	21	14A
INDIA	14B	7B	7B	7B	7B	14	14	14A	14A	14A	14	14B
JAPAN	14	14	7B	7B	7B	7B	7	14B	14B	7B	14	14A
MEXICO	21	14	14	7A	7A	7	14	21	21	21	21A	21A
PHILIPPINES	14	14	7B	7B	7B	7B	14B	14	14	14	14	14
PUERTO RICO	14	7A	7A	7	7	7	14	21	21	21	21	21
SOUTH AFRICA	14	14	7B	14	14	14A	21A	21A	21A	21A	21A	21
U. S. S. R.	7	7	7	7	7	14	14A	14A	14A	14	14	7B
WEST COAST	21	14A	14	7A	7	7	7A	14A	21	21	21A	21A

CENTRAL UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14A	14	14	7	7	7	7	7	14	14	14	14A
ARGENTINA	21	14A	14	14	14	7	21	21	21A	21A	21A	21
AUSTRALIA	21A	21	14	14	14	7A	7B	14	14	14	21	21A
CANAL ZONE	21A	14A	14	14	14	7A	14	21A	21A	21A	21A	21A
ENGLAND	7A	7	7	7	7	7	14	21A	14A	21	14A	14
HAWAII	21A	21	14	14	7A	7	7	7B	14A	21	21A	14A
INDIA	14	14	14	7B	7B	7B	7B	14	14	14A	14	14B
JAPAN	14A	14	14	7B	7B	7B	7	7	14B	7B	14	14A
MEXICO	14A	14	7	7	7	7	7	14	14A	14A	21	21
PHILIPPINES	14A	14	14	7B	7B	7B	7B	7A	14	14	14	14
PUERTO RICO	21	14	14	7A	7A	7	14	21	21	21	21	21A
SOUTH AFRICA	14	14	7B	7B	7B	7B	14A	21	21A	21A	21	21
U. S. S. R.	7B	7	7	7	7B	7B	14	14	14A	14	14	7B

WESTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7	14	14	14
ARGENTINA	21	21	14	14	14	14	14	21	21A	21A	21A	21
AUSTRALIA	21A	21A	21	14	14	14	14	14	14	14	21	21A
CANAL ZONE	21A	21	14	14	14	7A	14	21	21A	21A	21A	21A
ENGLAND	7A	7	7	7	7	7	7B	14	14	14A	14A	14
HAWAII	21A	21A	21	14A	14	14	14	7	14A	21	21A	21A
INDIA	14	14A	14	7B	7B	7B	7B	7B	14B	14B	14	14B
JAPAN	21	21	14	14	7	7	7	7	14	14	14	14A
MEXICO	21	14A	14	7	7	7	7	14	21	21	21A	21A
PHILIPPINES	21	21	14	14	7	7	7	7	14	14	14	14A
PUERTO RICO	21A	14	14	14	7A	7	14	21	21A	21A	21A	21A
SOUTH AFRICA	14	14	7B	7B	7B	7B	14	14A	21	21	21	21
U. S. S. R.	7B	7B	7	7	7B	7B	7B	14	14	14	14	7B
EAST COAST	21	14A	14	7A	7	7	7A	14A	21	21	21A	21A

A. Next higher frequency may be useful at this hour.

B. Very difficult circuit at this hour.

Good: 1, 2, 8-13, 16, 17, 19-27

Fair: 3, 4, 6, 7, 14, 18, 28-31

Poor: 5, 14

Note: VHF forecasts have been discontinue due to lack of reliable information.

Dear 73,

After reading some tower construction articles in the July issue of 73, I had a horrible thought; does the average ham realize what the common termite might do to a wooden tower, if given the chance?

Anyone constructing a wooden tower should take all precautions to prevent damage by termites or other pests or decay. Consult your local lumber or hardware dealer for the necessary materials to treat the wood and nearby ground to prevent any such damage.

George S. Stevens WB2ZFA
Mays Landing, N.J.

Dear 73,

I want to take this opportunity to comment on the incentive license study sections in your magazine. I think they are the best. Really, I'm learning more by your type of presentation than I ever could out of the Handbook. I believe that basically the Handbook is designed fror a person who has a basic knowledge of electricity and a little experience of the same. Coming in cold with absolutely no knowledge, the Handbook is very confusing to me. Most of the other hams in the club here think the same. In other words, fine business.

G. Gerald Burger WAØKUA
Secy. Huron Amateur Radio Club

Dear Kayla,

Decidedly like what you are doing. The humor is splendid and your Advance Class course is excellent. Keep laughing and the temptation to wring your hands is not so great. 88 to you too.

Jim Kaufman WAØRD
Boulder, Colorado 80302

Dear Kayla,

The big "40 meter push" which you presented in *73* depicts the beginnings of an excellent campaign. I'm all for, and would like to see *73 Magazine* present and lead a year long marathon designed to eliminate the interference caused by commercial stations on 40 meters. If 73 would follow through with such an "elimination marathon", I promise to urge most of the hams with whom I come in contact to support the campaign.

Possibly *73* can print up some pre-written complaint letters to be signed and mailed by US hams to Radio Moscow, VOA, BBC, etc. I bet we can lick the interference problem in one year with cooperation. How about it *73?*

Marty Hartstein WB6NWW
Long Beach, Calif.

OK, fellows, what say? I'll print up some form letters to be used as petitions. Let's give it a try. It can only cost postage and the work in getting signatures. Any other ideas from readers as to how to better make use of 40 will be appreciated and put to use.

Dear Wayne, Kayla, and Lin,

After a one year trial subscription I decided that *73* was great. I must say your editorials are right on the beam, so to speak. They are my thoughts entirely on almost every subject.

Keep up the good work and put in more humorous articles like Dilemma in Surplus (June '68). Keep putting in lots of ads, I read them word for word. And . . . best of all, put in more pictures with the articles, especially ones about decibels! HI HI.

Brent Christensen WAØSTS

Dear 73,

Thought that I would let you know that as lousy as the mail service is over here, I finally received my February issue of your most welcome bit of ham news from the States. My subscription was mailed to you in November at the same time that I mailed subs to the other two. I am getting 73 quite regularly even though late. I must say that I am a bit disappointed with the other two magazines as I have yet to receive my first copy. As you well know, there is no operation here and our only contact with the ham world in the states is through your magazines for which we are very appreciative. There are five hams in our group and by the time the magazine gets around, it is well dog-eared and equally as well read and appreciated. Keep up the good work. Just thought I would toss the roses where they are justly due. We do make good use of it and it does get passed around and then filed in the operating room.

Herb Wright WB6IHE
Saigon, So. Vietnam

Dear 73,

With great interest I read W2NSD's editorial on UFO's. I have been interested for several years in this subject. My views parallel those of the editorial and I hope in the near future I can assist in this proposed program. I do not know if there are any amateurs on this side of the pond that are interested but will do my best to find out. I think it would be of great value to have an arm of the network in Europe. I will keep my ears on 14250 and in the meantime try to scare up some interested parties on this end.

Richard J. Malby
APO New York 09176

Dear 73,

All US hams and relations visiting Spain are all times welcomed at the home of very old OM, V. S. Alexandersen, well known in the Amateur World between 1927-1936 as ET2X, ET3CS and ES3CX. I'm not active anymore, but I'm still a ham. Address Camino Son Toells 37, St. Augustin, Palma De Mallorca, Baleares, Spain.

V. S. Alexandersen

Dear 73,

Please pass along the word that I still have a bulk (300+) of National Zip Code Directory flyers to pass out free to anyone sending a request.

Earle and Marilyn McIvor
Box 8151, Rochester, N.Y. 14617

Caveat Emptor?

★ **Price—$2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.**

★ **Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.**

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DAVCO DR30 WANTED. State price and condition. J. A. Tyson, W9JXD. 5345 University Ave., Chicago, Ill. 60615.

WRL's USED GEAR has trial—terms—guarantee! SR46—$94.50; SR500—$199.95; HW12—$89.95; HW22—$89.95; Galaxy V—$289.95; Galaxy 300—$159.95; TX62—$99.95; 75A3—$229.00; 51J3—$395.00; NC-300—$149.95; RME6900—$149.95. Hundreds more—low prices—free Blue-Book list. Write WRL, Box 919, Council Bluffs, Iowa 51501.

VERY GOOD LATE MODEL NCX 3. Several modifications, outboard 10 kc receiver tune, ALC, and speaker. $150. AC power supply, $35. W7QBT, 890 W. 21 Street, Eugene, Oregon 97405.

WANTED, ANY CONDITION; VOM, VTOM, Weatstone Bridge. Resistance Decade Box, meter monuments. Gil Barber, 4155 E. Carey, Las Vegas, Nevada 89110.

NCX-5 MARK II and NCXA in excellent condition. $450 cash. Write K5TSR, 102 W. Rampart Dr., Apt. Q203, San Antonio, Texas 78216.

HALLICRAFTERS HT 32, like new, $250. Globe King 500A 160 through 10. CW. AM. with your exciter will run 700 watts SSB. ALC, extra final, VFO. $195, like new. 3-5 KVA generator, $200. Ship. John Smith, 1924 Dolphin Blvd., St. Petersburg, Florida 33707.

FOR SALE: HEATH SB-301 rec. with CW filter factory aligned, $260.00. Knight P2 SWR bridge, $10.00. Heath Kit H D-10 electronic keyer, $35.00. Instrograph code practice keyer with full set of tapes, $25.00. Ameco code practice oscillator and CW monitor, $5.00. Value of all equipment new, $390.00. Will sell individually or as package for $325.00. D. Willson, 7803 Dawn Rd., Cincinnati, Ohio 45237.

MODEL #28 KSR, $295.00. Write for list of 10 years' surplus, RTTY, FAX, etc. G. White, 5716 N. King's Highway, Alexandria, Virginia 22303.

WANTED: Issues of 73. Oct. '60 to Dec. '62, Jan. '66 to Dec. '67. Kirt Fanning, 6021 Edgewood, LaFrange, Ill. 60525.

FOR SALE: Motorola 80-D, 12v, complete and a Link 50ufs, 110v base complete, both on 52.525HZ. $120 for the pair. WA9GVE, 7424 Illinois Rd., Fort Wayne, Indiana.

FOR SALE: Clegg Apollo Six Linear Amplifier. Brand new! Below cost! Contact Jack Batts, Five Old Tavern Road, Wayland, Mass. 01778. Phone 653-6891.

NORELCO VIDEO TAPE RECORDER in perfect condition, tape and all additional parts included; CCTV camera—$115.00, Vidicon—$10.00, Vidicon Yoke—$10.00, Elgeet 4" Telephoto lens—f2.7; Reverb—$15.00; Simpson 260 VOM—$35.00; Heath RF Signal Generator IG-102, $15.00; EICO R-C Bridge & RLC Comparator—$18.00; Tachometer—$10.00. Wanted: 6M SSB Transceiver. WB2GKF, 506 Mount Prospect Avenue, Clifton, N.J. 07012.

FOR SALE: Complete Hallicrafters station in excellent condition. HT-37, and SX-100 with R-66B speaker. $300. James Winter, RR 2, Huron, S.D. 57350.

THE HAM-DINGER: Warren (Ohio) A.R.A. 11th Annual Hamfest, Sunday, August 25, Newton Falls, rain or shine. Follow arrows from Rt. 534 or Turnpike Exit 14. Talk-in stations, 10-6-2-. Prizes, swapshop, homebrew-code contests, XYL-YL program, ragchews galore. Food sold or bring picnic. For Hamfest bulletin write W.A.R.A., Box 809, Warren, Ohio 44481.

TWO METER FET PREAMPLIFIER. Typical specifications: 12 DB or better gain with less than 2DB noise figure. $10.95 postpaid. Communications Associates, P.O.B. 13275, St. Petersburg, Fla. 33731.

HALLICRAFTERS HT32B; $275; NC-300, $125; matching pr 813's GG linear with pwr supply, $50; TR-4 with ac pwr supply and speaker, $500. Beautiful. K6SUQ, 5 Rydal Court, Orinda, Calif. 94563.

WANTED: Heath-VX-1. Also G-76 AC power supply, must be in fine condition. Cash. G. Gysan, 53 Lothrop St., Beverly, Mass. 01915. Phone 922-3850.

FOR SALE: VHF EQUIPMENT: 6 meter SSB, HX-30 and HA-20 linear, factory wired, mint condition with manuals, $245.00. Gonset communicator II-B, 6 meters, 12/117v in mint condition with manual, $115. Gonset #3350, G-76 DC power supply (all transistor), $50.00. W1VYB-J. Gysan, 53 Lothrop Street, Beverly, Mass. 01915. Phone: 922-3850.

TOROIDS, uncased 44 or 88mH, also individually epoxy encased 88mH for standards, any 5, $1.50. 255A relay $2.10, 18B socket 70¢ all PP USA. E. W. Evans, K4OEN, 220 Mimosa Ln., Paducah, Ky. 42001.

"SAROC" FOURTH ANNUAL fun convention scheduled January 8-12, 1969, in Hotel Sahara's new space convention center, Las Vegas, Nevada. Advance registration closes January 1, 1969. Ladies program in Don the Beachcomber. Technical seminars, FM, MARS, RTTY, QCWA, WCARS-7255. Registration $12.00 per person entitles "SAROC" participants to special room rate $10.00 plus room tax per night single or double occupancy, admittance to cocktail parties, technical seminars, exhibit area, Hotel Sahara's late show, Sunday breakfast equal to any banquet dinner, ask any "SAROC" veteran. Brochure planned November mailing for details QSP QSL card with ZIP Southern Nevada ARC, Box 73, Boulder City, Nevada 89005.

RTTY GEAR FOR SALE. List issued monthly, 88 or 44 MHy torroids 5 for $1.50 postpaid. Elliott Buchanan & Associates, Inc., 1067 Mandana Blvd., Oakland, California 94610.

3000 V @ 3μF brand new GE Pyronal oil capacitors $3 each. Can mail. 3-lbs each shipping wt., FOB. P. Wandelt, RD # 1, Unadilla, New York 13849.

WANTED: Military, commercial, surplus Airborne, ground, transmitters, receiver, testsets accessories. Especially Collins. We pay freight and cash. Ritco Electronics, Box 156, Annandale, Va. Phone 703-560-5480 collect.

CLEGG VENUS 6 M SSB serial 100 33 w/ac ps and APOLLO LINEAR 1200 265. Both units recently factory checked. Included SS Booster 708 308. Everything $450.00. Eastern Penna. Write Box 968, c/o 73 Magazine.

SELL. Excellent CE100V, $495. Kent Markel, Box 144A RR 1, Lexington Park, Maryland 20653. 301-863-5967.

FOR SALE: SX101—$100; Knight R100A—$70; Ranger II—$150; DX60—$40; HW32—$75. Don Ahonen, Rt. 1, Bx 291A, Lisle Road, Owego, New York 13827.

WANTED: HA-10 LF/MF tuner, new or used. F. Rafalowski, 525 Home Ave., Trenton, New Jersey 08611.

SELL/TRADE: Collins mechanical filters, F455N-20 (2kc), F455N-30 (3kc), F455N-40 (4kc), on partially canabalized Collins sub-chassis 5407577006. Will remove filters or send sub-assembly. Trade for or buy 500kc filters for 51J4 receiver: F500B-31, F500B-14, F500B-08, or what have you that fits? W. A. Kernaghan, 1752 Kilohi St., Honolulu, Hawaii 96819.

FOR SALE: Thunderbolt. Complete with spare tubes. Will ship. $225. K6HLO, 511 Oak St., Roseville, California 95678.

THE CENTRAL NEW YORK CHAPTER OF QCWA will hold its annual banquet and meeting on September 28, 1968, at Hanson's Hotel, Oquaga Lake, Deposit, New York. Cocktail QSOs from 5 to 7 p.m. Buffet dinner at 7 p.m. and business meeting and election of officers at 8:30 p.m. All QCWA members are invited to attend and enjoy this program. Use exit 83 from the East, exist 82 from the West, on route 17. Tickets $5. For further information contact Clark Galbreath W2AXX, 111 Keeler St., Endicott, N.Y. 13760.

FOUR CORNERS FIELD DAY! September 21, 22. Club station K5WXI will operate 15, 20, 40 and 80 meters SSB and CW day and night. "5 Ø 7" award for working this station.

THE FOUNDATION FOR AMATEUR RADIO will hold its annual Hamfest on Sunday, September 22 from 1000 until 1700 hours at the Gaithersburg Fairgrounds in Gaithersburg, Md.

THE IOSCO RADIO CLUB presents its 4th annual Northeastern Michigan Hamfest on October 4, 5, 6 at East Tawas, Mich. 60 miles north of Bay City on US 23. Programs will begin Friday, October 4, at 6 p.m. ending Sunday afternoon at 3 p.m. For additional information contact Jerry Mertz W8DET or Glenn A. Pohl K8IYZ.

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October 1963
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INSTITUTE OF AMATEUR RADIO

73 Magazine

Wayne Green W2NSD/1
Editor, etcetera

October, 1963

Vol. XIV, No. 10

73 Magazine is published monthly by 73, Inc., Peterborough, N. H. The phone number is 603-924-3873. Subscription rates have just been hiked (after considerable warning) to $4.00 per year, $7.00 for two years, $10 for three years world wide. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in the U.S.A. Entire contents copyright 1963 by 73, Inc. Postmaster: please send form 3579 to 73 Magazine, Peterborough, New Hampshire. Save your eyes for the 19 pages of Buyers Guide, don't read this lackluster inconsequential.

de W2NSD

never say die

We had planned to have a nice four color cover this month, but so far I haven't received and color pictures that were really worth the extra effort. Our VHF station still is only partly assembled, so that was out. Send in those pictures so we can have a nice color cover.

More Help

One of our biggest problems here is the lack of people to get everything done. When you consider that it takes about 30 people to put out CQ and we have total paid staff of four plus Virginia and myself, you can perhaps appreciate that even high efficiency doesn't quite close the gap. We need more staff here.

We are still keeping our subscription and advertising rates low by keeping down salaries, so we don't have an awful lot to offer in money. The usual starting salary is $50 (plus room and board, which does make it a bit more attractive), with raises as we see results. Living is quite reasonable up here in the mountains and $50 goes a long way. We have some fringe benefits too, like Blue Cross, lunch breaks, free parking, etc. Perhaps you might count in little extras like operating our mountain top hamshack.

What do we need? Well, we sure have a need for a technician that can build anything we need, repair our gear as fast as it burns out, hook up new gear and test it, and so forth. Then we need someone to take charge of the circulation of the magazine, seeing to it that every known parts jobber is pressured until he carries 73 on his counter, keeping track of the fortune that we are losing on our newsstand sales (I figure we lose 5c for every newsstand copy sold), chasing expired subscribers until they renew their subscription, etc. This is a good job because it doesn't take any previous experience, only the ability to work hard and get things done.

Every now and then I look helplessly at the growing pile of mail that I'll never be able to answer. I could use someone who can write letters and who has a fairly good ham background to take 90% of these away from my desk. We could use some help in preparing articles for printing too. There are lots of things to be learned here for the fellow who wants to work. After a short time you could find yourself somewhat of an expert on letterpress and offset printing, printing production, magazine production, typesetting, layout, photography (including developing and printing pictures), operation of a copy camera, offset press, platemaking, paper purchasing, artwork, bookkeeping, accounting, radio repairs, tower climbing, antenna tuning, contest operating, and much, much more. And you'll learn more about the inside workings of ham radio than you ever imagined existed. You'll learn things that can never be put on paper.

Interested? Drop me a line and plan on spending a couple of weeks with us as a trial to see how you fit in with our group and how you are able to grab hold of things. We all get along marvelously and there just isn't time for me to include a psychotherapy treatment for newcomers.

If you're married there are apartments here in town for about $75 a month that are just fine. If you're not living in we can up the ante a bit.

New Hampshire is one of the most beautiful parts of the country and even our winters are short and beautiful. The snow last year lasted just three months and I never had to shovel it once. They really keep it clear up here.

So, if you're interested in a permanent job in ham radio, or even if you want to learn about publishing and printing, you might give some thought to working up here.

6-UP

Things have gotten out of hand. I had planned to put out a small (16 pages) monthly bulletin with an eventual circulation of maybe 2000. From the experiences of VHF

(more on four)

Amateur and VHF Horizons, this seemed like a reasonable estimate.

Jim Kyle sent in the copy for the first issue, 16 pages, and we ran off 1000 copies on our little offset press. It was a good issue, with a couple of terrific articles on Wide Band Balun Design and on SSB T-Pad design. We ran no ads in the first issue. The idea behind 6-UP was that we could run articles that were of interest only to the VHF'er and thus might not find room in 73. The fast press dates involved assured that the magazine would be in the hands of the readers in days after news occurred instead of the usual weeks or months.

By the time the last copy was off the press the 1000 copies had been sold out and subscriptions were backing up. We printed 1000 more. Most of these are gone now. On the basis of this circulation I set out a letter to VHF manufacturers setting a ridiculously low ad rate of $10 a page. Then it happened!

Bob Cooper, publisher of VHF Horizons, called and within a short while we had a deal whereby 6-UP would take over the Horizons mailing list. Suddenly our circulation was up to almost 6000! Several advertisers took us up on our ad rates and this brought our second issue up to 32 pages. Our paper supply that was supposed to last for six months (2000 copies 16 pages) disappeared into the press as we ground out 6000 copies of 32 page magazines. Dan W1AER ran the press for almost 24 hours straight getting the issue out on time. Ted K9YOE just about ruined his arm cutting paper and trimming magazines. Fred W1NJL, taking time off from contests, did his best to get the pages in the worst possible order, figuring that any VHF reader worth his salt should be able to sort out the jumble. Jim WØDSU had a lot to do with the unbelievably crooked folding that resulted. The first thousand copies were sort of fun, but by the 6000th enthusiasm had flagged to a new low.

Needless to say we are increasing the ad rates a bit to hold down the number of pages of ads. $30 page, $15 half page. Bargain.

Further Ham Tours

Our trip to Europe has worked out so successfully that we want to start planning more such trips. Pan American has a round-the-world flight which costs under $1000. This seems like a lot of money, but few people manage to include a round-the-world trip into their lives . . . and it is something that you'll never forget, as long as you live. The hotel and incidental costs would be on top of that, but

(Continued 98 pages later)

Do it yourself

Jim Kyle K5JKX
1236 N.E. 44th Street
Oklahoma City 11, Okla.

WIDE BAND FM TRANSCEIVER

For quite some time now I have been bandying about "idea" articles in these pages—so we might as well warn you at the outset that this is another of them. The gadget hasn't yet been built, but on paper offers a relatively simple way for anyone interested in wideband FM work (there's a lot of it going on) to get there even if he can't obtain a surplus police, etc., unit.

The major innovation presented here is not really new, having been used by the military in the BC-1336 years ago, but hasn't had as much attention as it deserves. That is the use of a single crystal to control frequency of both the transmitter and the receiver in a superhet; this both cuts crystal cost in half and allows virtually instant frequency change within the limits of the most-often-used parts of any FM band.

Since the purpose of this article is to stimulate ideas rather than to present a blow-by-blow account of how to build such a gadget, the system design has been left in block-diagram form as shown in Fig. 1. Of the 10 tubes envisioned, seven are in completely conventional circuits and will not be discussed further.

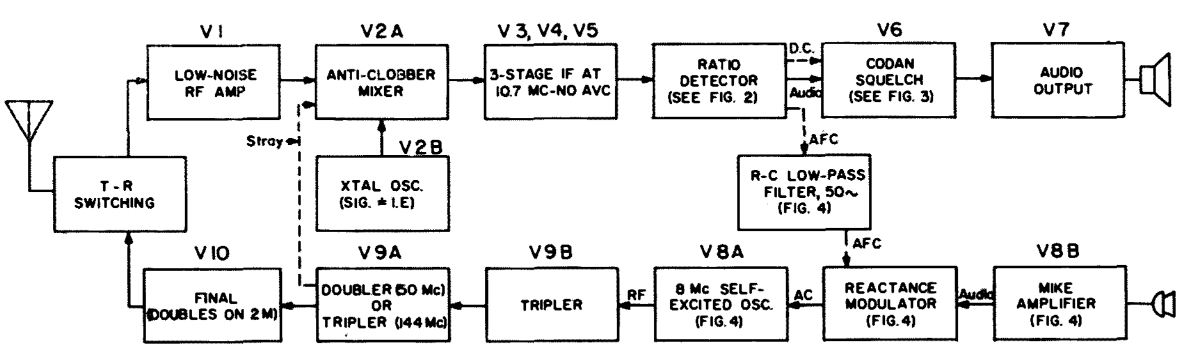
Please note, however, that the "low-noise rf amp" can be anything up to and including a paramp, while the "final" may similarly be anything up to and including a pair of 4CX-1000's. This transceiver is *not* limited to mobile or low-power use.

The unusual or unfamiliar circuits employed here are the Codan squelch, V6; the audio output, V7 (unfamiliar only in that a relatively new tube with great promise is used); the mike amplifier-self-excited oscillator, V8; the ratio detector; and the reactance modulator. Taking them in the order in which they appear in Fig. 1, let's examine the ratio detector first.

If you have been around TV or hi-fi servicing, you already know this circuit, but bear with us. It is built around two semiconductor diodes and a special transformer; the schematic appears in Fig. 2. Briefly, when the incoming signal is precisely in the center of the channel, both diodes produce dc output of exactly equal amplitude but opposite polarity. As the incoming signal goes to one side of center, output of one diode rises while that of the other falls off, giving an unbalanced output. When the signal goes the other way, the reverse happens.

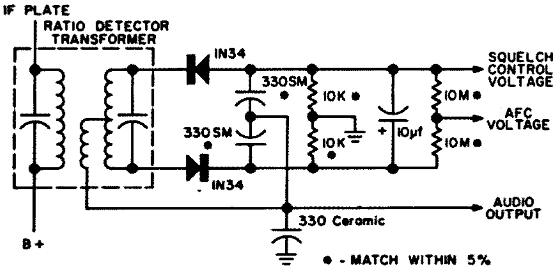
The electrolytic capacitor produces self-limiting, by preventing any audio voltage from appearing across the two load resistors in series at any time. The audio resulting from frequency modulation, however, shows up at the center-tap of the series capacitor string and moves on to the next stage.

A dc control voltage is taken off across the electrolytic for the squelch circuit, V6. This voltage is present only when a signal is being received. Another dc control voltage is taken off from the midpoint of a resistor string across the electrolytic; this point is at ground potential when the incoming signal is centered, goes positive when incoming signal is off-center in one direction, and goes negative when incoming signal is off in the other direction. It is filtered through an R-C low-pass filter with cutoff in the neighborhood of 50 cycles to remove any audio variations, and applied to the reactance modulator as afc (automatic frequency control) voltage.



CONVENTIONAL CIRCUITS: V_1, V_2, V_3, V_4, V_5, V_9 AND V_{10}.

UNUSUAL OR UNFAMILIAR CIRCUITS: V_6, V_7, V_8, RATIO DETECTOR AND REACTANCE MODULATOR.



RATIO DETECTOR SCHEMATIC
FIGURE 2

This afc provision allows the receiving oscillator crystal to control frequency stability of the transmitter as well. During transmission, the receiver oscillator, mixer, *if* strip, and detector are left in operation. They pick up enough output-frequency signal to put a strong signal through the *if* strip and into the detector. There, the afc produces a control voltage which keeps the transmitting oscillator tuned to the desired frequency despite any desire on the oscillator's part to drift haphazardly.

Squelch action is provided by V6. This tube consists of a triode-pentode hooked up as shown in Fig. 3. With no voltage on the pentode grid, this section conducts rather heavily and produces a large voltage drop across its plate load resistor.

However, this plate load resistor is also in the grid-cathode path of the triode section, which serves as first audio amplifier; the aforementioned voltage drop puts so much grid bias on the triode that it is cut off and no audio can get through.

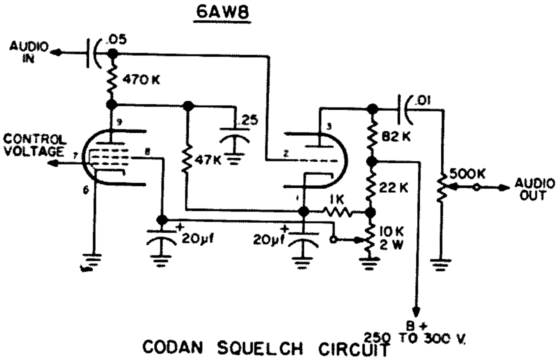
When sufficient negative voltage is placed on the pentode grid, this section cuts off and plate-current flow through the resistor ceases. The triode can now operate normally, passing audio signal.

If the dc for the grid of the pentode is obtained from a source which is dependent upon incoming signal, audio will pass only when a signal is being received. While waiting for a contact, nothing will get through to the speaker. The dc voltage furnished by the detector is of this nature.

Exact amount of voltage required for the conduction-to-cutoff transition is determined by the screen voltage applied to the pentode. Supplying this through a potentiometer provides a simple "squelch level" control.

Audio output from V6 goes to audio output tube V7, a type 6BQ5/EL84. Developed for TV use, this little 9-pin bottle delivers a full 4½ watts of power with only a few volts of driving signal. Since the ratio detector can be expected to provide from 1 to 5 volts of signal, and this is amplified from 10 to 30 times by the codan tube, you should have plenty of gain available! Full data on the tube, including typical operating conditions under a wide range of applications, is available from Amperex Electronic Corp., Hicksville, Long Island, N. Y. The circuit itself is entirely conventional and is not shown here.

Having reached the loudspeaker, it's time to move over to the microphone and take a look at the transmitter's beginning.



CODAN SQUELCH CIRCUIT
FIGURE 3

The mike amplifier, V8B, is a conventional audio amplifier using the pentode section of a type 6EA8 tube. It produces about 3 volts output from a ceramic mike, and about half that from an ordinary-quality dynamic. The only unusual part here is use of an Ohmite type J pot as a plate load resistor, to allow an output-level control with the minimum number of parts. The circuit is shown in Fig. 4, along with the reactance modulator and the self-excited oscillator.

The reactance modulator makes use of a voltage-variable capacitor, otherwise known as a silicon power rectifier, to achieve what is at the moment at least the utmost in simplicity for an FM modulator. The diode is reverse-biased by the large resistor running to the B-plus line; in this condition, its capacitance will change with any variation in voltage across it, and the change will be almost completely linear over a quite wide range. The *frequency* change (not capacitance) as a function of voltage change is linear to within 1 percent for a 40-percent change from original frequency. Thus, by simply applying a fraction of a volt of audio to this diode, which forms part of the frequency-determining tank of the oscillator, we can produce perfect FM.

The oscillator itself must not be designed for extreme stability, since anything which tends to increase stability makes it that much harder to get FM. On the other hand, all leads should be mechanically solid, etc., since the *only* FM we want is that coming from the microphone! The slug-tuned coil shown for the tank is rec-

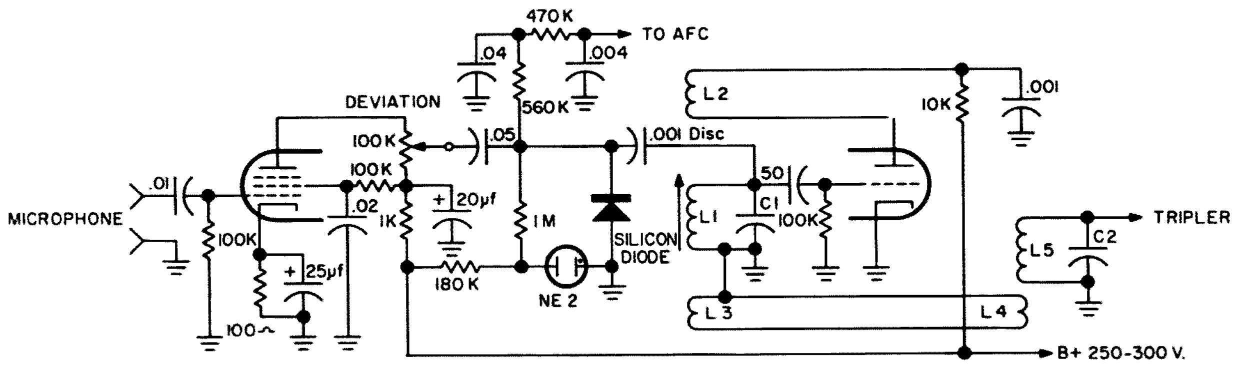


FIGURE 4

Fig. 4—Mike preamp, reactance modulator, AFC low-pass filter, and self-excited oscillator circuitry. Tube is a 6EA8. Stage grounding should be as shown. NE-2 regulates reactance-modulator bias voltage. L1-C1 and L5-C2 both resonate at 1/6 desired output frequency; L2 is 3-turn link at cold end of L1; L3 and L4 are one-turn links at cold ends of respective coils, connected by twisted-pair with single-point ground. 100K pot in pentode plate circuit controls frequency swing of modulator and should be set for maximum audio without breakup, using receiver known to have 15-kc discriminator bandpass.

ommended to allow easy initial tune-up.

Choice of the Armstrong oscillator was made on the basis of adaptability to commercially available coils; a Hartley or Colpitts is equally acceptable, providing only that you steer clear of the high-C circuits and make sure to include the coupling for the diode. Failure to make the diode part of the oscillator tank will mean failure to achieve the FM you are setting out to obtain.

From here on out to the antenna, follow standard VHF procedures. The only reason for including final-doubling to reach 144 mc was to maintain the tube complement at 10. If you don't mind another tube and want better output, add a doubler or a tripler and run the final straight through.

A few words about some of the other circuits and the way they are used: No avc is provided for the *if* strip in order to achieve a degree of limiting; it's almost impossible to overload an amplifier in FM, since class C provides the best limiting possible. Addition of 1000-ohm resistors in each *if* grid, between *if* transformer and grid, would help in this regard. The "T-R switching" indicated in Fig. 1 may be anything from a simple relay (probably the easiest) to a complex network of vacuum tubes (on 50 mc at least). In switching from transmit to receive, the cathode path of the receiving rf amplifier should be broken to prevent tube damage and the audio output should be disabled in some manner because the transmitter signal used for frequency control will also open the squelch. On receive, of course, all transmitting circuits should be dead.

For an exceptionally efficient mobile rig, you might consider using a transistorized crystal oscillator and mike preamp, and putting them in a tiny control head up front. The squelch control can also come up front since it carries only dc, and audio volume can be controlled with a pad across the speaker lines. Everything else can repose in the trunk. In this way, you can have instant frequency change and full control, without sacrificing legroom in the passenger compartment.

As we said at the beginning, this is an *idea* article rather than a blow-by-blow construction account. Make any changes or modifications you like. For example, the only reason for using 10.7 mc as the *if* is that ratio-detector transformers for this frequency are readily available. You can also use 4.5 mc, 1500 kc, or even 455 kc if you don't mind image-response troubles. These as well as any other modifications are strictly up to you.

Depending on whether your crystal frequency is above or below the signal frequency, you may find that the afc circuit refuses to hold in properly. This will be due to reverse polarity, so that the "correction" signal is actually increasing the error. The cure is to reverse polarity of the diodes in the ratio detector, also reversing the electrolytic capacitor at the same time. The squelch control voltage should always be taken from the *negative* end of the electrolytic.

So there you are. Dig out the back issues of 73, get some scratch paper, and let's see some more WBFM across the country!

. . . **K5JKX**

WHY JOHNNY HAM CAN'T HEAR

(with apologies to Rudolph Flesch)

Why is it you strain to hear a choice bit of DX everybody else is working and you can't hear even a beat note with the gain wide open? Or, you call and call a station and he works everybody but you? You're getting out—didn't you just work W2NSD/1 way up there in New Hampshire? Well, relax—there's a solution. Not a complete one, but it may answer some of your questions on frequency propagation.

As ridiculous as the old cliché sounds, you gotta hear 'em to work 'em. Yet, like an iceberg, there's much more below the surface than you see on top. The frequency propagations columns in amateur publications may say that the path to some DX area will be open on 14 mc. Great! But what these predictions mean—and they're just predictions—is that the maximum useable frequency (MUF) will be at, or above, 14 mc most of the days of the month. Some of the days it'll be below 14 mc. The MUF is a highly variable thing.

Let's talk a bit about the MUF then. It's directly related to the ionized layers that surround the earth. These layers—the D, E, and F layers—make high frequency communication possible beyond the line of sight. Their height and electrical composition reflect the rf wave back to earth at a distance. Most of you know, this distance is proportioned to the layer height, the angle at which the rf strikes the layer, and the layer's state of ionization. The ionization determines the highest frequencies to be returned to earth. In general, frequencies higher than the MUF are not returned and are limited to line of sight communication only.

Normally, a frequency known as the optimum traffic frequency (FOT) is chosen for the more permanent commercial circuits. The FOT is 15% below the MUF so variations in the MUF will not affect it greatly. The FOT should result in a solid circuit.

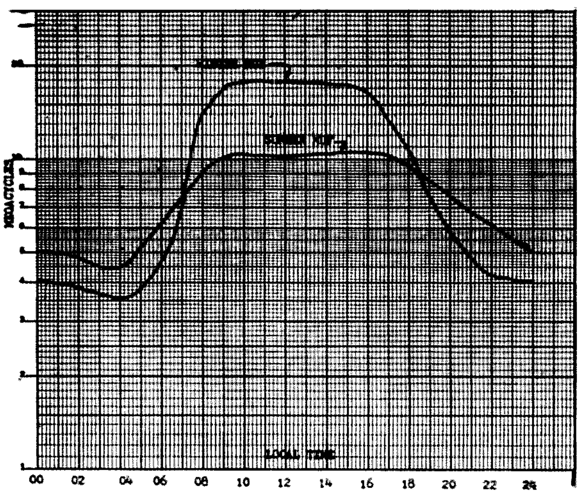


Fig. 1. Path length 1000 miles.

Since the layers are caused by the sun's radiation, you'd expect them to vary from month to month. That's exactly right. Fig. 1 shows typical summer and winter MUF's for a 1000 mile path. Several similarities are immediately apparent. First, the MUF's during the night hours do not differ greatly. Second, the dip just before dawn isn't really a dip. The MUF decreases sharply as the night passes, and the sudden sunrise raises it abruptly. The MUF rises until the ionized layers are saturated and can pass no higher frequency.

So—you're on this MUF (or FOT) trying to raise some DX and you can't make the grade! What's wrong? Well, it's possible that for your power and antenna you're not high enough in frequency! Now wait just a cotton-picking minute, you say—the F layer won't

Jim Lee W6VAT
Box 45621
Los Angeles 45, Calif.

support a higher frequency over the path and yet I'm not high enough? Yes—for your power and antenna—you're not high enough!

There is a lowest useable frequency (LUF) associated with any communications path, no matter how long. The LUF has ruined your chances of working DX more times than once. That old cliché was a left-handed way of saying LUF. You must put a signal into the other guy's receiver before he can hear you.

The obvious question is "just how do I go about doing this." Well, it's not an easy question to answer. Putting in enough signal at the other end suggests a certain "required field strength" at the station. Stop and think a minute about how your signal gets there in the first place.

Obviously, it travels up the feedline and is radiated by the antenna. Their efficiencies are less than 100%, so you've lost power right away. Next, if your antenna has any gain, your signal will be concentrated in some form of beam. You haven't gotten any lost power back—you've just focused what's left. Then it travels up through the D and E layers to the F layer. The F layer reflects the signal back down through the D and E layers. Power is lost both on the way up and the way down. In reality, the D layer causes most of the losses.

Bouncing off the earth, your signal is reflected up toward the layers again. This process keeps up as long as your signal is hopping across the miles to the DX. Though your signal started out at a hundred watts, when it arrives at the DX station it could be only microwatts!

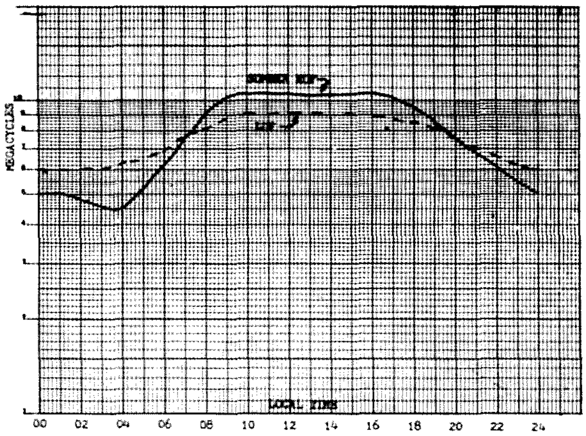


Fig. 2. Path length: 1000 miles; transmitter: 500 watts; noise level: 3; antennas: ½ wave dipoles, ½ wave high; mode: 15 WPM CW

Different types of emission—AM, CW, RTTY, and SSB—require different field intensities to be workable signals. For example, CW has a 17 db margin over AM. On CW you don't need sidebands, and the receiver selectivity can be made very high to eliminate most of th noise. AM fone must be at least 3 kc wide and the noise in the receiver will be much greater. The AM carrier serves no useful purpose as far as the information content is concerned and yet it uses up most of the power! No wonder the swing to SSB!

So, you've succeeded in putting in a microwatt signal at the DX station—can he hear you? Well, maybe yes and maybe no. What kind of an antenna and receiver does he have? What is his local noise level—is he in the tropics or the arctic? If he has a poor receiver and antenna plus being in the high noise regions of the tropics you probably won't be heard. The arctic auroral zones add to the attenuation of your signal so it may be only millimicrowatts—not enough to be workable.

Figs. 2 and 3 show typical LUF curves compared with the MUF's of Fig. 1. During the summer day hours, the particular path is marginal. Signals will be weak and fading. In the winter, the situation is much better. Communication is possible over most of the day on some frequency. You'll notice that the MUF has nothing to do with the LUF. The LUF is a calculated frequency based on the transmitter power, the two antennas used, the local noise level, the receiver, and any special absorption areas in the propagation path. It's

entirely possible for the LUF to exceed the MUF and no communication will be possible.

It's possible to get gross LUF calculations for a general DX area by making some simplifying assumptons. You assume only half-wave dipoles at each end, mediocre receivers, and a higher-than-expected noise level. Manuals which cover the subject more thoroughly are available for calculatiing LUF's.[1, 2]

Most hams wouldn't go through the tedious calculations required for LUF's, and you can't blame them. It takes about 6 to 8 hours for the whole process once you know what you're doing. It must be done on an individual basis—station by station. Not an inspiring way to spend your time and one of the reasons the magazines don't print them.

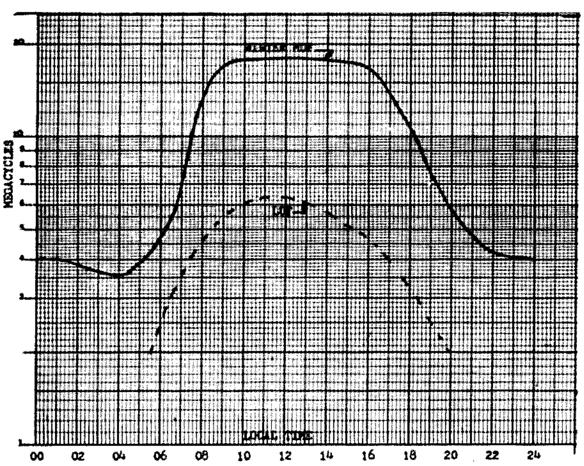


Fig. 3. Path length: 1000 miles; transmitter 500 watts; noise level: 3; antennas: ½ wave dipoles, ½ wave high; mode: 15 WPM CW

If calculations are not for you, the next best thing is an idea of what to do to avoid the LUF and its effects. This is simple in one sense—difficult in another. You can raise your power—use a California Kilowatt. Fine approach except it's illegal and it won't solve the problem. It's perfectly true higher power will push the LUF down. The problem is how much power? Doubling your power gives only a 3 db increase in field strength. Translated to frequency this may be only a few hundred kilocycles—hardly enough most of the time.

Even if you try to burn a hole through to the DX, just ask yourself this question—"how many DX stations have I worked that were running less than 100 watts?" Plenty I'll bet! That's because your antenna and receiver were doing a good job, and this is much closer to the real problem.

[1] Ionospheric Radio Propagation, Circular 462, National Bureau of Standards.
[2] Radio Frequency Propagation, TM-11-499, Department of the Army.
Both of these are available through the Superintendent of Documents, Washington, D. C.

You really need the best antenna you can get, the quietest location, and a good receiver. It's been said—a dime in the antenna is worth a dollar in the transmitter. How about *your* antenna? Did you use good insulators, solder all the connections and wrappings properly, or did you just twist the wires and let it go? You'd be surprised how much noise an unsoldered antenna joint can make in a gentle breeze.

Do you have the proper feedline for your antenna and is your transmitter and receiver SWR low? Yes, I said receiver. When you need every microwatt you can get to work DX, it seems silly not to match the receiver to the antenna. If you can possibly build a beam antenna for the frequency—do it!

When was the last time you aligned the receiver properly, or checked the tubes? Is everything on the nose for sensitivity and selectivity? Is there something you could do to improve the effectiveness of your receiver?

Like the weather, there's not much you can do about noise levels unless they're man-made. Many city power departments have interference bureaus which will check out your noise complaints free of charge. Faulty thermostats, leaky power line insulators, arcing neon transformers, and the like, all can cause heavy local interference. The unfortunate thing about these noise sources is that they may not be on during the working day of the interference bureau. Such was the unhappy situation at W6VAT a number of years ago. These nighttime noises can only be run down by effort on the ham's part, but it's always worth it.

Atmospheric and cosmic noises are the predominant sources of QRN in most locations. A low noise receiver isn't a help since atmospheric and cosmic noise below 30 mc is about 40 times greater than that generated in your receiver. A receiver noise figure of less than 10 or 12 db is not worth the effort.

Always operate as close to the MUF as possible. You won't need excessive power and your signals will have less losses in reaching the DX station. It is not always possible to be close to the MUF *and* have the desired DX station there too. Sometimes the DX is on a lower frequency and you must adjust accordingly. Here, the LUF will hurt you the most. The lower the frequency, the higher the noise level, the harder it is to build a good antenna. All the other variables plus operating skill must be in your favor. It will take effort, but when you have done your best, the LUF will be less of a problem—at least as far as you're concerned.

. . . W6VAT

Why Fight Ohm's Law?

Don Gunter K5HPT
Route #2, Box 304
Denham Springs, La.

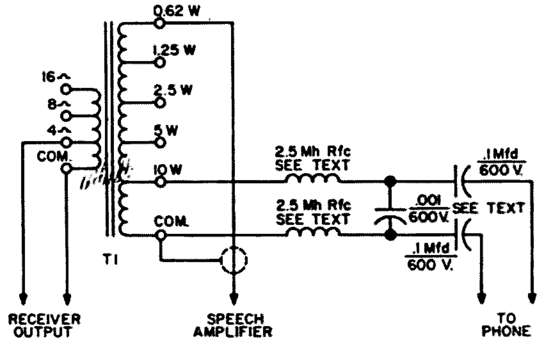
Ever wish you had a fone patch, but didn't know where to scrounge a transformer? well, if you don't happen to have one in your junk box, they're cheap, cheap.

First, let's review what a fone patch does. It's merely an impedance matching device, to match the 500 ohm telephone line to the low impedance output of your receiver, and to the high impedance input of your speech amp.

One of the things often forgotten in impedance matching is that a low impedance will work perfectly into a high impedance, provided you have sufficient output voltage. (Have you ever taped a broadcast by patching your high impedance tape recorder input to the receiver speaker leads?) We can't make any claims for efficiency or maximum power transfer, but we couldn't care less in this application.

With that out of the way, let's see what we can do about hooking up a fone patch.

At K5HPT, the receiver output is 4 or 8 ohms. We're using a high impedance (50K) dynamic mike into the speech amp. Searching through the catalogs for a cheap multi-tap transformer to match 500 ohms to 4 ohms and



T1- 70.7 VOLT LINE TRANSFORMER, KNIGHT NO. 62 G 077

FONE PATCH

FIGURE 1

50,000 ohms proved fruitless. Then we spied a tapped 70.7 volt line-to-voice-coil transformer. The specs read: Primary-4, 8, 16 ohms; Secondary watt taps-10, 5, 2.5, 1.25, 0.62.

Whipping Ohm's law out of our hip pocket, we figured that $R = E^2/W$. Assuming a purely resistive load (good enough for this purpose), the impedance of any secondary tap is $Z = 70.7^2/W$ or:

10	watts =	500 ohms
5	=	1,000
2.5	=	2,000
1.25	=	4,000
0.62	=	8,000

Refer to Fig. 1, and we've got it made. We can match the receiver to the line perfectly, and the 0.62 watt tap provides more than adequate drive to the speech amp. The transformer cost only $2.41, and is available from Allied Radio Corporation, Chicago, Illinois.

The filter consisting of CI and the two rf chokes may be unnecessary. It's used at K5HPT because rf pickup in the telephone line outside the shack caused a feedback problem.

One word of caution. Don't skimp on the two 0.1 mfd 600 volt condensers. They block dc from the transformer, and, more important, prevent placing a load on the telephone line.

Now get busy and enjoy the thrill of patching in two old friends and letting them chat over your rig—it's worth it.

. . .K5HPT

an announcement of significance to all amateur radio operators

The Heath Company takes pleasure in introducing on the following pages, the first of a complete series of fully integrated SSB amateur radio equipment that will set new standards for value, quality, style, and performance. To be designated the Heathkit SB Series, these products represent a major step forward in amateur radio SSB equipment. Now, the best in SSB design features are combined with Heathkit's leadership in electronic kit techniques to bring maximum performance and operating convenience to amateurs at modest prices.

What design features are essential or desirable for the best SSB performance? Some of the more important ones are high mechanical and electrical frequency stability achieved only by employing crystal-controlled heterodyne circuitry with low frequency variable frequency oscillators, optimum receiver selectivity and minimum transmitted signal bandwidth obtainable by means of the excellent shape factors exhibited only by crystal or mechanical filters, linear tuning with 1 kc dial calibration, smooth anti-backlash dial, automatic level control, small size, and light weight. The SB Series has all these plus the several improved and unique features listed below.

To provide even better performance plus maximum ease of assembly, these new Heathkit SSB products also feature linear dials providing 500 kc frequency coverage per bandswitch position while maintaining 1 kc calibration marks spaced approximately ⅛" apart, a high frequency bandpass IF (8.4—8.9 mc) for improved image rejection and suppression of spurious responses, preassembled and prealigned LMO (linear master oscillator), circuit boards and wiring harnesses, plus specially tooled cabinet, knobs, dial mechanism, and LMO components. When the transmitter and receiver are operated in the transceive mode, in addition to the usual practice of employing a common VFO and high frequency oscillator, the receiver BFO is used as the transmitter carrier oscillator to prevent even minute frequency changes between transmit and receive due to crystal tolerances. This attention to detail is typical of the careful, thorough engineering behind the Heath SB Series.

Only Heathkit experience and know-how can provide the engineering and manual skills necessary to bring such quality and performance to kit-form SSB equipment. Despite this background, Heath engineers spent over two years in the design of the equipment, and the developing and specifying of the critical components (such as the LMO, crystal filters, and dial mechanism). Only the most capable manufacturers have been selected to supply the special components and, as always, only the highest quality parts are employed throughout.

Carefully read the features and specifications of the SB-300 SSB Receiver described on the next two pages. The entire SB Series will exhibit all these fine performance characteristics using the same basic critical components in equipment covering all amateur interests.

HEATH COMPANY

Benton Harbor, Michigan

HEATHKIT® by Daystrom

SB-300 features

- Complete coverage of 80 through 10 meter amateur bands with all crystals furnished, plus provision for VHF converters
- Crystal-controlled front-end for same tuning rate on all bands
- 1 kc dial calibrations—100 kc per dial revolution provides band spread equal to 10 feet per megacycle—tuning knob to dial ratio approx. 4:1
- Provision for transceive operation with matching SB-400 Transmitter (available soon)
- Prebuilt linear master oscillator (LMO), wiring harness and two heavy-duty circuit boards for fast, easy assembly
- Professional styling and features throughout for finest HF and VHF amateur band communications

Experienced amateurs will especially appreciate the careful attention to detail behind the design of the SB-300. Its many features include a crystal controlled front-end that provides the same tuning rate on all bands, a pre-built Linear Master Oscillator (LMO) for linear tuning with 1 kc dial calibrations, built-in crystal calibrator and 2.1 kc crystal-lattice bandpass filter, a smooth, non-backlash vernier dial drive mechanism, and a beautifully styled cabinet and panel. Cabinet top opens completely for easy access to top chassis components. Optional AM and CW filters are low-cost and easily installed, their steep-sided bandpass eliminates, not merely attenuates, adjacent interfering signals for exceptional reception.

Circuit features include a high frequency I.F. for maximum I.F. and image rejection, audio inverse feedback, fast-slow-off AGC control, stability of 100 cps after warmup, and a host of other deluxe features that assure finest communications results. Order your SB-300 now for 60% savings over comparable factory-built receivers! A matching Transmitter, 1 KW Linear Amplifier, and an All-Band SSB Transceiver will be available soon!

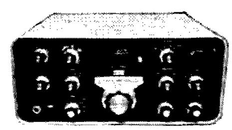
Kit SB-300....17 lbs.....no money dn., **$25** mo........ **$264.95**
SBA-300-1 CW Crystal Filter (400 cps)....1 lb........ **$ 19.95**
SBA-300-2 AM Crystal Filter (3.75 kc)....1 lb........ **$ 19.95**

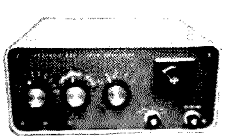
Check the superb specifications below and see what a tremendous dollar value the SB-300 represents!

Frequency Range (megacycles): 3.5 to 4.0, 7.0 to 7.5, 14.0 to 14.5, 21.0 to 21.5, 28.0 to 8.25, 28.5 to 29.0, 29.0 to 29.5, 29.5 to 30. **Intermediate frequency:** 3.395 megacycles. **Frequency stability:** 100 cps after warmup. **Visual dial accuracy:** Within 200 cps on all bands. **Electrical dial accuracy:** Within 400 cps on all bands. **Backlash:** No more than 50 cps. **Sensitivity:** Less than 1 microvolt for 15 db signal plus noise-to-noise ratio for SSB operation. **Modes of operation:** Switch selected: LSB, USB, CW, AM. **Selectivity:** SSB: 2.1 kc at 6 db down, 5.0 kc at 60 db down (crystal filter supplied). AM: 3.75 kc at 6 db down, 10 kc at 60 db down (crystal filter available as accessory). CW: 400 cps at 6 db down, 2.5 kc at 60 db down (crystal filter available as accessory). **Spurious response:** Image and IF rejection better than 50 db. Internal spurious signals below equivalent antenna input of 1 microvolt. **Audio response:** SSB: 350 to 2450 cps nominal at 6 db. AM: 200 to 3500 cps nominal at 6 db. CW: 800 to 1200 cps nominal at 6 db. **Antenna input impedance:** 50 ohms nominal. **Muting:** Open external ground at Mute socket. **Crystal calibrator:** 100 kc crystal. **Front panel controls:** Main tuning dial; function switch; mode switch; AGC switch; band switch; AF gain control; RF gain control; preselector; phone jack. **Rear apron connections:** Accessory power plug; HF antenna; VHF #1 antenna; VHF #2 antenna; mute; spare; anti-trip; 500 ohm; 8 ohm speaker; line cord socket; heterodyne oscillator output; LMO output; BFO output; VHF converter switch. **Tube complement:** (1) 6BZ6 RF amplifier; (1) 6AU6 First mixer; (1) 6AB4 Heterodyne oscillator; (1) 6AU6 LM osc.; (1) 6AU6 second mixer; (2) 6BA6 IF amplifier; (1) 6AU6 Crystal calibrator; (1) 6HF8 1st audio, audio output; (1) 6AS11 Product detector, BFO, BFO amplifier. **Power supply:** Transformer operated with silicon diode rectifiers. **Power requirements:** 120 volts AC, 50/60 cps, 50 watts. **Dimensions:** 14-7/8" W x 6-5/8" H x 13-3/8" D.

WATCH FOR THESE NEW HEATHKIT RELEASES!

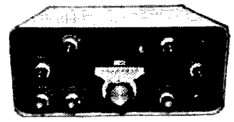
SB-100 ALL-BAND SSB TRANSCEIVER

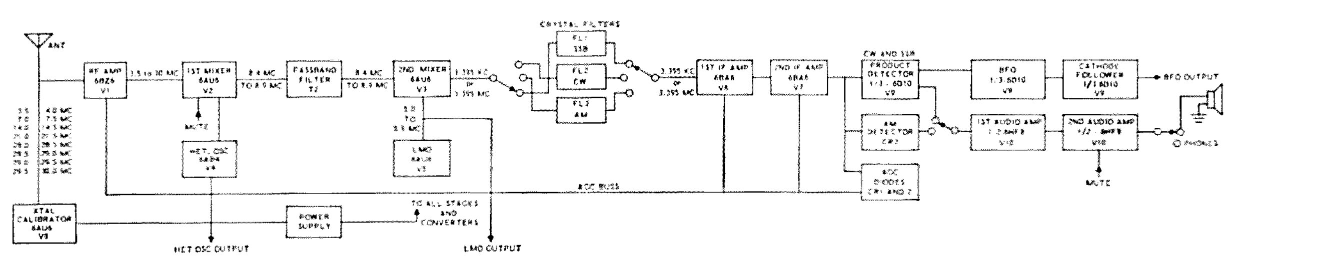




SB-200 1 KW LINEAR AMPLIFIER

SB-400 SSB TRANSMITTER





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Propagation Charts

The monthly frequency predictions for this page are made, in accordance to fixed rules, from Basic Data compiled by the Bureau of Standards. The technique is quite complex. There are six parameters, four of which are known precisely, and two variables. The four known are distance, direction, time of day, and month of year. The two variables are sunspot numbers and height of ionosphere. These last two can be used only as averages and cause the day-to-day variations in frequency behaviour.

This month 28 MC (10 meter band) is indicated as workable for a few hours on some circuits. On good days it's worth a try. If it doesn't work, drop to 21 MC. Likewise, 21 MC shows up on some circuits for a few hours. If it doesn't work, drop to 14 MC.

J. H. Nelson

EASTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7	7	7	7	7	7	7	7	14	14	14	14
ARGENTINA	14	14	14	7	7	7	14	21	21	21	28	21
AUSTRALIA	14	7	7	7	7	7	7	14	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	14	21	21	21	28	21
ENGLAND	7	7	7	7	7	7	14	21	21	14	14	7
HAWAII	14	14	7	7	7	7	7	7	14	14	21	21
INDIA	7	7	7	7	7	7	14	14	14	14	7	7
JAPAN	14	7	7	7	7	7	7	7	7	7	7	14
MEXICO	14	7	7	7	7	7	7	14	14	21	21	21
PHILIPPINES	7	7	7	7	7	7	7	14	14	7	7	14
PUERTO RICO	7	7	7	7	7	7	14	14	14	21	21	14
SOUTH AFRICA	7	7	7	7	7	14	14	21	21	21	21	14
U.S.S.R.	7	7	7	7	7	7	14	14	14	14	7	7

CENTRAL UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7	14	14	14	14
ARGENTINA	14	7	7	7	7	7	14	21	21	21	28	28
AUSTRALIA	21	14	7	7	7	7	7	7	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	14	21	21	21	28	28
ENGLAND	7	7	7	7	7	7	7	14	14	14	14	7
HAWAII	14	14	7	7	7	7	7	7	14	14	21	21
INDIA	7	7	7	7	7	7	7	14	14	7	7	7
JAPAN	14	14	7	7	7	7	7	7	7	7	14	14
MEXICO	7	7	7	7	7	7	7	14	14	14	21	14
PHILIPPINES	14	14	7	7	7	7	7	7	14	7	7	14
PUERTO RICO	14	7	7	7	7	7	14	21	21	21	21	21
SOUTH AFRICA	14	7	7	7	7	7	14	14	14	21	21	14
U.S.S.R.	7	7	7	7	7	7	7	14	14	7	7	7

WESTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7	14	14	14
ARGENTINA	21	14	7	7	7	7	7	14	21	21	21	28
AUSTRALIA	21	21	14	7	7	7	7	7	14	14	21	21
CANAL ZONE	21	14	7	7	7	7	7	14	21	21	21	21
ENGLAND	7	7	7	7	7	7	7	14	14	14	7	7
HAWAII	21	21	14	7	7	7	7	7	14	14	21	21
INDIA	14	14	7	7	7	7	7	7	14	7	7	14
JAPAN	14	14	14	7	7	7	7	7	7	7	14	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14	21
PHILIPPINES	14	14	14	7	7	7	7	7	7	14	7	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	21	21	21
SOUTH AFRICA	14	7	7	7	7	7	7	14	14	21	14	14
U.S.S.R.	7	7	7	7	7	7	7	7	14	14	7	7

Es means the possibility of a high MUF and/or freak conditions.

PROPAGATION FORECAST

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
GOOD	■	■	■	■	□	□	■	■	■	■	■	■	■	■	■	■	□	□	■	■	■	□	□	□	■	□	□	□	□	□
FAIR	□	■	■	□	■	■	□	■	■	□	□	□	□	■	■	□	■	■	□	□	□	■	■	■	□	■	■	■	■	■
BAD	■	□	□	■	■	■	■	□	□	■	■	■	■	□	□	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
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□ = INDICATES PREVALENT CONDITIONS

New Products

Lafayette Catalog

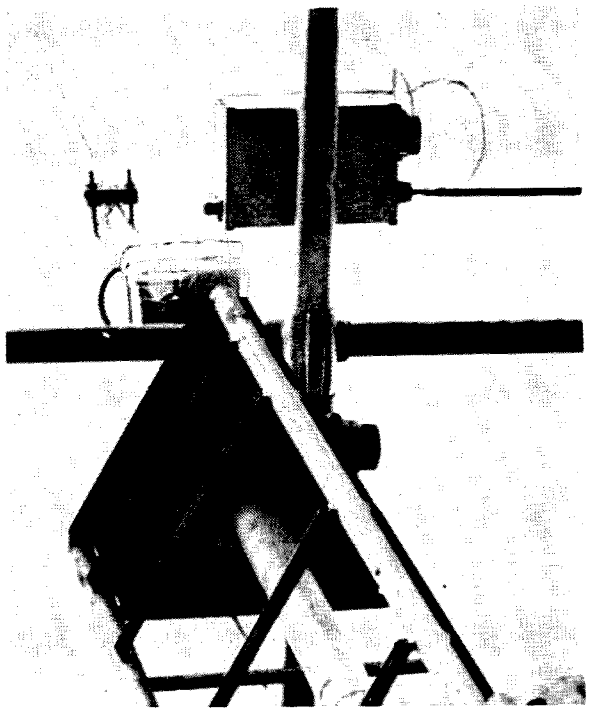
Lafayette has just brought out their 1964 catalog. Though this is rushing the season a bit, the catalog is a corker. Not only does Lafayette carry a gigantic supply of parts, but they have a big line of ham gear. Drop a card to Lafayette Electronics, Syosset, New York.

HX-50 Accessory

Hammarlund has announced a little gadget for their HX-50 sideband transmitter which permits you to zero beat by means of an external switch (like a foot switch). Kit form is $12.50, wired $20. Write Hammarlund, 53 West 23rd Street, New York 10.

THREE ELEMENT REMOTELY TUNED YAGI

Ronald Lumachi WB2CQM
73 Bay 26th Street
Brooklyn 14, New York



An aerial view of the beam and gamma section in its operating position.

Many novice amateurs, after digesting the first thrills of radio operation begin to search out the elusive DX QSO, but the inadequacy of standard equipment (dipoles, long wires, etc.) does not provide this satisfaction. Their radiation characteristics preclude a concentrated and directed rf pattern. To answer the needs of the radio operator, I have designed an easily assembled, remotely tuned, light weight, yagi-type array that will answer the DX problems of the many amateur radio enthusiasts.

The Gamma

We are all aware of changing antenna characteristics with respect to ground potential, however, few will brave the operating heights of their antenna supporting structures to make the critical beam adjustments necessary for maximum transferral of radio frequency power. This somewhat dangerous task has been partially eliminated by the insertion of a remotely tuned gamma matching arrangement which can be permanently affixed to the antenna boom.

The unit proper is mounted in a 3x5x7 inch minibox, and driven by a 1 rpm motor. A wide-spaced variable condensor coupled to this unit provides the necessary capacitance to tune out any reactance. The capacitance is placed in series with the center conductor of the co-ax line and fed through a porcelain in-

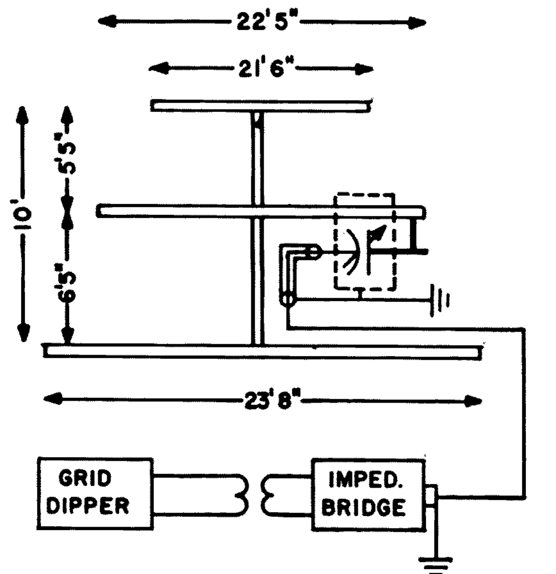
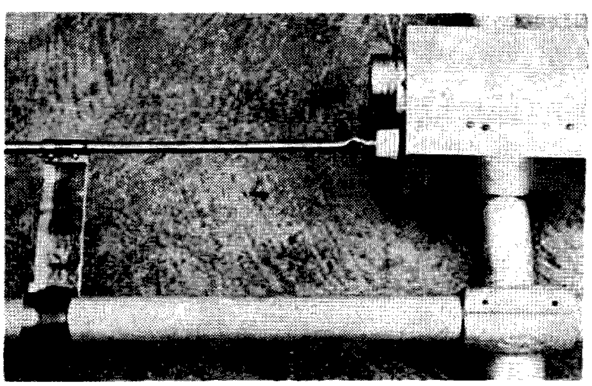


FIG. 1

LT



The gamma rod, minibox container, motor, feed-thru insulator and aluminum cross.

sulator to the standard gamma matching rod. This particular type system was chosen since its unbalanced characteristics are particularly well suited to the coax type coupling arrangement. The shield of the 50 ohm cable is grounded to the minibox via the SO239 connector which is affixed to the minibox. This is in turn mounted to the exact center of the middle (driven) element. Needless to say, the series capacitor must be insulated from ground through poly-styrene or other low loss material, and should have sufficient plate to stator spacing to provide a margin of safety for ones

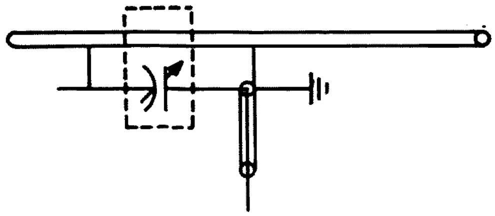


FIG. 2

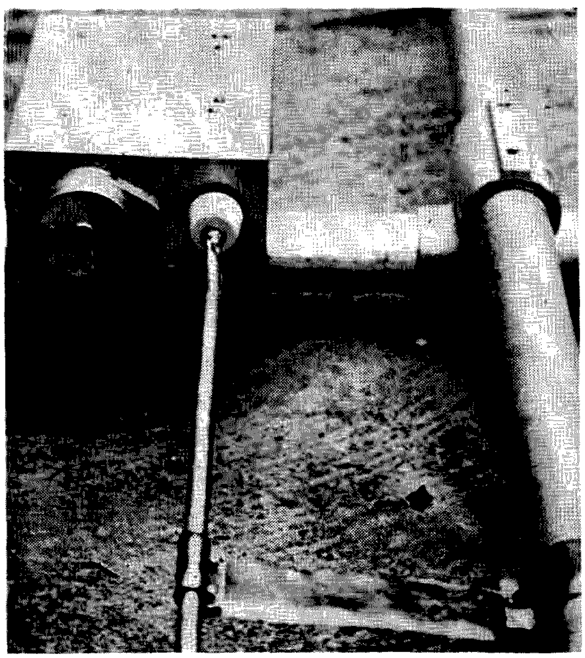
LT

particular power limits. I had a 250mmfd 2KV variable lying around the shack and it was pressed into service. My object was to keep cost at a minimum and to use material that was on hand where possible. This part was one manifestation of the many bits of equipment bought on various trips to Cortlandt Street, however, it is not unique in nature and others can be easily substituted. The amateur must remain flexible if cost consideration is a prime factor.

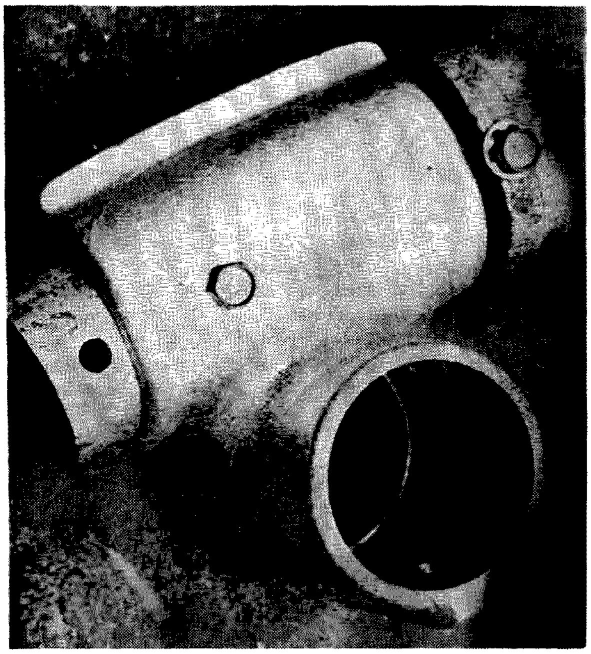
The gamma matchbox can be made in the work shop on the inclement days of winter whereas the actual beam fabrication, because of its unusual dimensions, has to be constructed in the yard.

The Antenna

The boom is a standard length of electrical aluminum conduit pipe 10′ x 1¼″ (pipe is measured by the inside diameter). The secret to this particular beam, construction-wise, is the use of the Nu-Rail 1¼″ aluminum crosses which are far superior to the oxen yoke-type arrangements commonly available to the am-



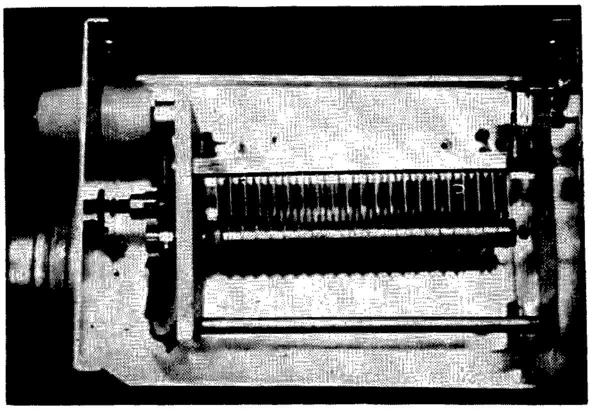
A side view of the gamma rod, insulator, driving motor, copper bracket, and aluminum cross.



An enlarged view of the aluminum cross is in series with a plumbing "T" connection. The "T" is in series with the mast support and the cross is perpendicular to the "T." The bolt's head visible in the photo is to provide additional support and prevent movement. The bolt is fitted through both ends of the cross and secured with a nut.

ateur. The crosses are more flexible in their uses, provide a greater degree of rigidity, support more weight, are less brittle and comparable in price. The elements are standard tube dimension that telescope perfectly for subsequent critical antenna adjustment. The elements are composed on one length of 12′ x 1½″-.058 wall tubing (tubing is measured by the outside diameter) which is attached at the boom center by the crosses. Telescoped two feet into both ends is a length of 6′ x 1⅜″ .058 wall aluminum (12′ length cut in half). Our dimensions thus far have netted us 12′ + 4′ on each side for a total of 20′ of element breadth. To make up the additional footage for either 15 or 20 meter operation, standard 1¼″ TV masting can be applied. For 15 m. one additional mast can be cut to make up the additional footage. For 20 m. operation additional material will be required. I might add incidentally, that the novice amateur after receiving his coveted General need only telescope the lengths of his elements and move into the 20 m. spectrum. With this in mind, full 10′ lengths of TV masting might be inserted fully into a telescoped position and allowed to extend short distances for 15 m. operation. At the later date, they need be only re-telescoped, adjusted to the new dimension,

(Read Swan ad then flip page)



A close-up view of the capacitor, driving gear coupling, feed-thru insulator and motor.

and retuned remotely in order to provide 20 m. operation.

I have determined, by the formula contained in the ARRL Antenna Handbook, that the element dimensions are generally as follows:

1. Driven ...... 22' 5" (475 ÷ Fmc)
2. Director ..... 21' 6" (455 ÷ Fmc)
3. Reflector ..... 23' 8" (500 ÷ Fmc)

Needless to say, there are no hard and fast rules to determine exact element length. Ground charactristics, antenna height, and surrounding obstacles all contribute greatly to antenna operation. My antenna is situated atop a 71' support and rotated by a prop-pitch motor. It might easily change its characteristics if I were to place it astride my chimney supported by a short length of pipe or pole, and driven by the more common TV CDR rotator. The burden of critical adjustment lies with the particular amateur and contingent upon the peculiar aspects of one's installation.

The gamma matching rod is ⅜" copper tubing (chosen because it can be soldered). The sliding arrangement is made from a length of copper flashing which is approximately 6" from driven element to matching stub. Both ends are bent around their respective elements and fitted with galvanized, stainless steel, or copper nuts and bolts. Once the proper impedance and tuning is completed they can be secured to prevent movement.

The test arrangement is standard, employing a grid dipper coupled loosely to an impedance indicating device. A length of co-ax cable should be cut to a multiple of a half wave to insure that the impedance of the antenna will be accurately reflected in the bridge device. The stub should be moved along the elements until a fifty ohm resistive value is determined. At the same time tuning is carried out with the remotely activated gamma and the point chosen where the combination of stub and gamma movement nets the desired result. SWR might then be determined to insure accurate tuning.

As mentioned in the ARRL handbook, a compromise between gain and front to back ratio is the best that can be strived for, since one is usually had at the expense of the other; however, a treatise on antenna design and pecularities are beyond the scope of this article. Reference is made to chapter 4, Multi-element Directive Arrays of the ARRL Antenna Handbook, 1960. Juggling with reflector length and/or element spacing can provide satisfaction for one's particular needs. It will probably be found, however, after exhaustive hours of experimentation, that the actual dimension will not vary greatly from those determined by formula.

The ground work has been laid and a general course has been charted for the design of a satisfactory beam. Cost factors have played an important role in the tri-element endeavor. My intention was to provide the most flexible beam arrangement keeping in mind my desire to move in and out of the several DX bands allotted to the amateur. Flexibility and ease of construction have been the keynote.

Construction Notes

1. Element to element conductivity, heretofore given little emphasis by the amateur, has been considered in my undertaking. A lubricating and highly conductive material manufactured by the Burndy Company of Norwalk, Connecticut and called Penetrox A has been incorporated. It has been designed for the electrician and available at electrical supply houses. Infinitesimal changes due to corrosion on aluminum joints are now reduced with the use of this ingredient. The element joint need only be lightly scuffed along the length of contact, and this material liberally applied. This not only provides a low resistant path for the rf, but also prevents the aluminum from becoming fused due to the corrosive tendency of the weather. Its application will insure smooth revamping of the elements when changes are contemplated.
2. In order to insure against wind noise, the ends of the elements should be plugged with cork. Before insertion, they can be dipped into shellac to prevent rotting and to provide a secure fit. The boom ends can also be corked which, in addition, will reduce the surface area and lessen the wind stress.
3. The ends of the elements should be slit with a hack saw and the hose clamps applied. It can be readily seen that a tighter fit will result.

4. It might also be well to drill several small holes in the bottom of the minibox to provide drainage for moisture etc.

5. The small 1 rpm motor can be mounted either inside or outside the minibox. Convenient holes are provided which allow easier attachment to the outside of the box. Small gears attached to the shafts of the motor and condenser provide the coupling necessary to drive the capacitor. The 1 rpm motor was chosen since it allows for a more exact degree of adjustment. A length of lamp wire can be lightly coupled to the terminals of the motor before installation which will provide the ac voltage to drive the unit. It can hang loosely to the base of the supporting structure where tuning might be effectuated; once tuning is completed it can be pulled down. A permanent installation might include a length of wire taped to the coax line and allowed to enter the shack. Tuning might then be carried out in the comforts of one's home.

Parts List

Antenna

1—3 lengths 12'x1½"-.058 wall aluminum tubing*
2—3 lengths 12'x1⅜" .058 wall aluminum tubing*
3—1 length 10'x1¼" TV mast aluminum tubing (15 meters)
(6 lengths 10' TV masting if 20m operation is contemplated)
4—3 NU-Rail aluminum crosses 1¼"*
5—12 stainless steel aircraft-type hose clamps 1½"
6—6 1¼" thermos corks
7—Tube of Penetrox-conductive material

Gamma

1—3x5x7 aluminum minibox
2—approx 140-250 mmfd variable condenser
3—porcelain feed-thru insulator
4—SO 239 co-ax receptacle
5—30" length of ⅜" copper tubing
6—1 rpm motor-Barry Electronics—Broadway, N. Y. C.

**Available from Whitehead Metal Co. 12th Ave. & Christopher St., N. Y. C.*

. . . WB2CQM

Vernon Trexler W5IUR
2142-B 35th
Los Alamos, N. M.

Rules of Thumb

or

How to Get in the Ballpark and Stay

1. Removing the cathode by-pass condenser reduces gain to approximately one-half.
2. Removing the screen by-pass condenser reduces gain to approximately one-tenth, and in some cases causes instability.
3. When you calculate the power dissipated in a resistor by the power formula, double this value when you pick the resistor.
4. Cathode by-pass condenser's impedance at the lowest frequency you want to pass is usually one-tenth the resistance of the cathode resistor.
5. Increasing size of coupling condenser lowers frequency response, increases hum and instability, and vice versa.
6. Screen by-pass condenser's impedance at the lowest frequency you want to pass is usually one-tenth the resistance of screen by-pass resistor.
7. To vary rf gain, vary the screen voltage of the pentode or tetrode.
8. When you have tuned grid tuned plate circuits at the same frequency, plan to neutralize all tetrodes, pentodes and triodes in rf amplifiers. Never mind who said you didn't need to.
9. Multiply the Q of a coil by its calculated impedance to get the impedance of a parallel tank circuit.
10. Build on a steel chassis for better audio shielding.
11. Use brass, copper or aluminum chassis and shielding for rf. These materials have less effect on the tuned circuits.
12. Coils should be spaced coil diameter away from surrounding objects for best Q. Again, use non-magnetic material for shielding.
13. Coil shapes in general should be two parts long to one part high for best form factor.
14. Build your VFO's, etc., strong like a battleship for best stability.
15. Build all your frequency determining circuits, dials, shafts, coils, condensers, etc., on the same mounting plate for best stability.
16. Phenolic, lucite, and poly are fine, but for minimum VFO drift use ceramic coil forms and stand-offs.
17. Ceramic NPO trimmers are good, but air trimmers are better for VFO's, etc.
18. Regulate screen voltage and perhaps plate voltage of your VFO, but try regulating the filaments, too, if you want a stable VFO.
19. Just because it's single sideband both sidebands are there, one just has more signal strength than the other. If you have 40 db of sideband suppression and the signal generated is 40 db over S9, then the suppressed sideband is S9, and a carrier suppressed 50 db would be around S7 or S8 on a perfect S meter under the same conditions.
20. In general, an S meter reading means the receiver is turned on.
21. To get out well and have your CQ's answered in general, 100 watts seems to be the break-over point on AM; but if you really want to get out, go full power, use a beam, and raise the antenna height.
22. Why shield linear amplifiers? In general, they don't generate TVI.
23. Audio for communication is about 300 to 3000 cycles—what's yours?
24. Beginners tend to make circuits too elaborate. Keep it simple, it will last longer and work better.
25. Crystal current causes drift, 60 ma is far too much.
26. Power transformers can put out 30 to 50 per cent more current in intermittent amateur service than their published value. In SSB this value can be 100 per cent or more of peak load.
27. A 1 db change of audio is barely detected by the ear. A 3 db change is a prominent change.
28. Some tubes turn blue in operation, but generally it means the tube is gassy and is a "flat" tube which draws more than normal current and should be replaced.
29. Don't expect a circuit used from a book or magazine to work the first time. First, the article goes through too many hands to be

QLF

Karl Kopetzky K9AQJ

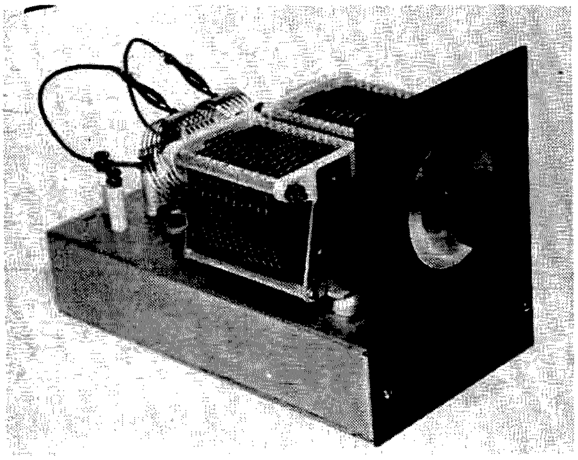
Well I never thought that I'd see the day when the well-known ham term *OM*, standing for *Old Man* would accurately describe *yours truly*. When I first started in ham radio, some half-century ago, then called "wireless," there was no such term. The *ARRL* had not yet been born, and the oracle was the venerable *Hugo Gernsbach* of *Electro Importing Company* fame. I never found out what it was that *Hugo* imported, but it was an experience to go thru his store on Cortlandt Street in New York City.

Where was I? . . . Oh, yes, back about 50 years! Well, like I was saying, the *ARRL* had not yet come into being, and *The Old Man* who was later to be so well-known for his pithy (*watch that spelling, typesetter!*) remarks about modulation and operating practises was, for all that I know, *The Young Man*. Anyway, it was but a scant 7 years later that the term OM was to become common, and it was to laugh that I, with the dawn of babyhood still on my rosy cheeks, at the tender age of 14 would be called OM, or Old Man. Now that I *am* an Old Man . . . jeeese, I could do without it!

Some of the fondest memories I have of "those good old days" were when after operating for hours and hours at the key of the half-gallon spark set, I finally made it a solid QSO with a station just 3 miles away! But the thrill of thrills was when I read in the forerunner of *QST* that *1SW* had been copied solid in Nauen, Germany! That's not bad for spark!

Still later I was to face an enraged father at about 3 AM in the top floor of his home where I had a "generator" running to furnish the High Voltage to four *Western Electric* VT-2's in parallel in a *Hartley Osc.*, and was told unceremoniously to "get the H--l to bed and to stop this infernal noise. And furthermore, I don't give a D--m whom you are talking to." My Dad, God love him, was a Colonel of the Army even at home. So I mentally saluted him in the fashion I thought

(Turn to page 43)



Fred Herr W3WPV
911 Old Manoa Road
Havertown, Pa.

Photos by: Thomas C. Rudolph

Combination Antenna Coupler

A notice from the FCC usually indicates improper operation of radio transmitting equipment. One of the worst bugaboos of improper operation is the emission of harmonics which fall outside of the amateur bands causing possible serious interference to other services.

The purpose of this article is to describe an antenna coupler that will help reduce the emission of harmonics and at the same time provide a better match between the transmitter and the antenna. As the name implies, it is a combination coupler because it can be readily changed from series operation to parallel operation by simply changing two jumper connections.

Before starting the coupler discussion let us see what happens between the transmitter and the far end of the antenna. The most efficient antenna is one that is cut to a definite length for a single operating frequency. Efficiency falls off when this antenna is used on any other frequency. However, the average amateur radio operator does not have the means or the space to erect a separate wire for each frequency that he wants to operate on. Consequently, most of his operating is done on one antenna. It might load up nicely and put out good strong signals on any one of several frequency bands, but not being designed for one single frequency, it will have a tendency to emit signals on a frequency of double, triple, and more, of the fundamental frequency. When this happens your incoming cards take on a drab appearance and do not have the bright colors of a QSL.

Right then is a good time to take a look at your transmission line. Actually, the best time to take this look is before the cards from FCC begin to roll in.

Harmonics of the operating frequency are generated inside the transmitter, and if there is nothing to stop them they will be flung by the antenna in all directions along with the

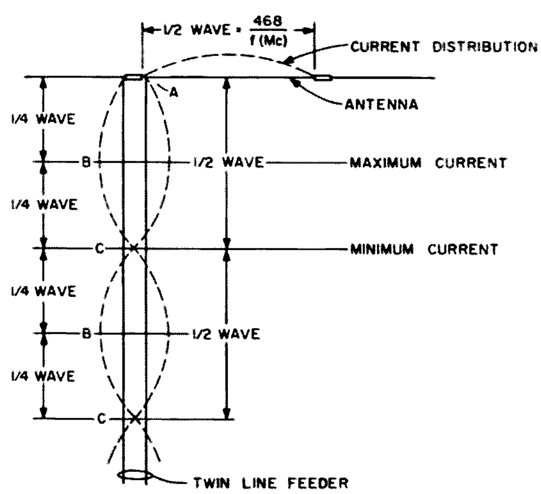
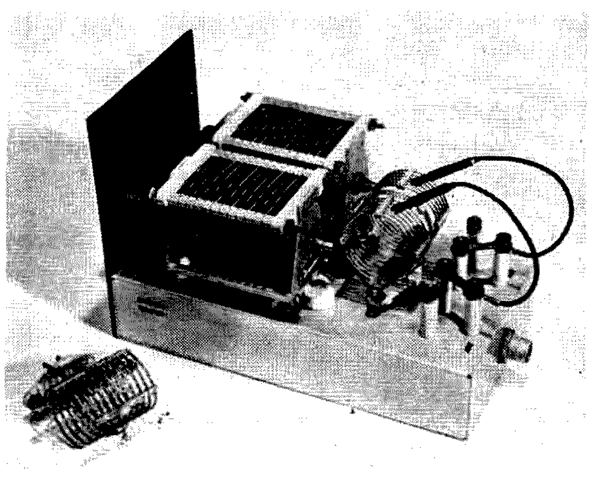
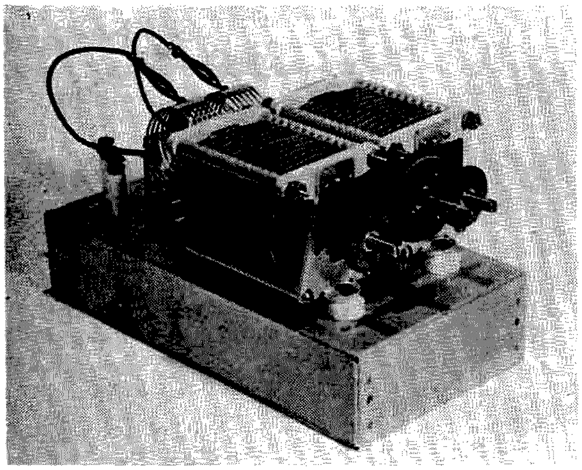


FIGURE 1

fundamental signal. The handbook says that harmonics can be greatly reduced by means of an inductively coupled circuit in the transmission line and continues at great length to discuss the advantages of antenna couplers. In reading the handbook discussion we find that a coupler, in addition to its ability to attenuate harmonics, provides a dandy means of matching the transmitter output impedance to the antenna input impedance. With these two items of equipment properly matched, the tank circuit of the transmitter is working efficiently and the greatest amount of power is transferred to the antenna. However, a discussion of impedance matching, as such, is outside the scope of this article. We started out to deal with antenna couplers as a weapon against green eyed harmonics and will proceed with the story.



Antenna theory says that the best place to insert a coupler in a feed line is at a point of maximum current or minimum current. For use at a point of maximum current, a series tuned coupler is required; at a point of minimum current a parallel tuned coupler is needed. To save a thousand words take a look at Fig. 1. The diagram shown here will serve in an elementary way to locate the two current points referred to. In keeping with utmost simplicity an end-fed half-wave Zepp antenna is illustrated. The dotted lines indicate the distribution of current in the antenna and feed line. Because the antenna is cut for a half wave, the value of current is at a minimum at each end and at a miximum in the center. In the case of the feeder, the value of current at A, where the feeder connects to the antenna, will be at a minimum. Other points of minimum current will be at points marked C, each a half wave apart. The points of maximum current are at locations marked B, which are also a half wave apart.



The length of the feeder line is usually dictated by the location of the antenna. In order to get the antenna in an area clear of trees and buildings, it might be necessary to use a long feeder line. The line between the coupler and the antenna should be cut to a length equal to a quarter wave or a multiple of a quarter wave. If the chosen length happens to be an odd multiple of a quarter wave the end of the line at the coupler is at a point of maximum current, such as at points B, and the use of a series tuned coupler is indicated. If the line length is equal to an even multiple of a quarter wave, a parallel tuned coupler is needed because it will be inserted at a point of minimum current. The line from the transmitter to the coupler can be any length.

The feed line to a folded dipole, which is a different type of antenna than that illustrated, can be of any suitable length. In this case it would be necessary to determine, through experiment, which type of coupler tuning will give satisfactory antenna loading. The amateur is forever experimenting with his antenna in the hope of finding the best combination of antenna, feeder, and location. For this reason a coupler should be used that could be readily changed from series to parallel tuning and thus avoid the necessity of having two pieces of equipment which are almost alike.

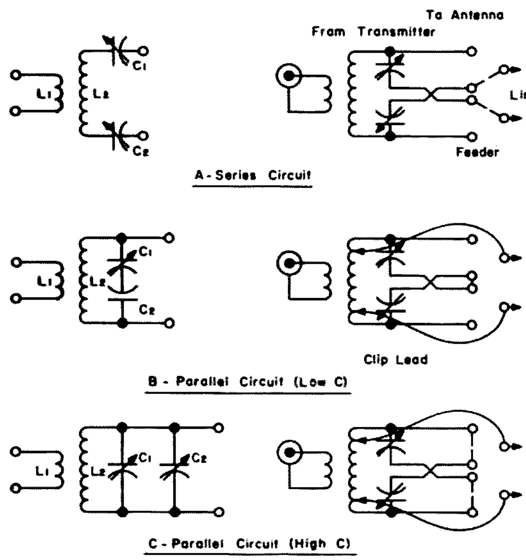


FIGURE 2

The basic diagrams of antenna couplers are shown in Fig. 2. Diagram A is for a series tuned coupler. Diagram B is for a parallel "low C" coupler and C is for a parallel "high C" coupler. Opposite each basic diagram is the actual circuit for each type of coupler. Here is where the advantage of a combination coupler is realized. To change from one type of tuning to another it is necessary only to arrange the interconnecting links as indicated by the dotted lines on the diagram.

Each link is made from a piece of copper or brass strip with a hole in each end, the holes spaced 1" apart on their centers. The links are supported on porcelain through-panel insulators and held in place with knurled battery type nuts for easy removal. Ordinary copper wire can be used in place of the links.

The coupler is constructed on 5" x 9½" x 2" aluminum chassis. A co-ax connector is provided for the input from the transmitter. The output connections are for twin-lead, but a co-ax connector may be used if desired. The panel is a piece of ⅛" tempered masonite with two coats of Du Pont black wrought iron paint and the dial pointer is the red arrow from a Gem safety razor blade dispenser. The placement of wiring is not critical, but it should be arranged as symmetrically as possible.

Fig. 3 shows the construction details of the link end of the chassis. No details are given for locating the coil and condensers as this will depend on the parts available to the constructor. The through-panel insulators, however, should be located accurately to the dimensions shown so that the links can be readily interchanged between any two of the insulators. All parts are mounted on the top surface of the chassis and the wiring is concealed inside. The two condensers are mounted on stand-off insulators to insulate their plates from the metal chassis.

Another good feature of the coupler is the method of driving the condenser shafts. As can be seen in the photographs, each shaft is fitted with a fiber gear. The two gears are driven by a third fiber gear whose shaft extends through the panel to the dial. This arrangement makes for easier tuning and insures both sides of the feeder being in balance.

16th EDITION

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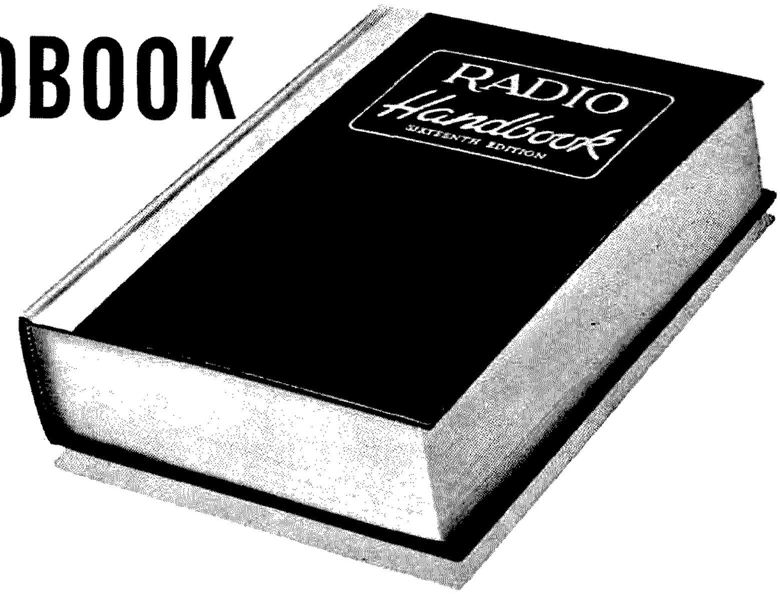

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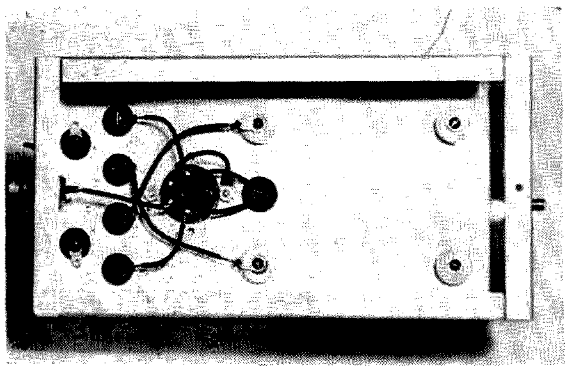

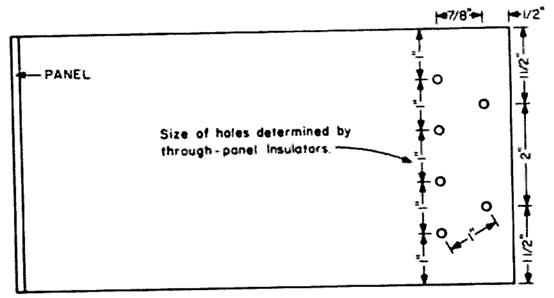

PLAN OF 5" x 9 1/2" x 2" CHASSIS

FIGURE 3

The condensers used in the model pictured are each 150 mmfd because they were on hand at the time of construction. According to B & W literature, the JVL and BVL coils will resonate through their respective bands with 100 mmfd condensers.

With the links arranged for series tuning, the condensers are in series with the antenna feeder wires. With the links arranged for parallel "low C" tuning, the two condensers are in series with each other and in parallel with the coil. In the parallel "high C" arrangement, both condensers are in parallel with the coil. Where the antenna feeder system indicates the use of parallel tuning it should be possible to get satisfactory loading with either the "low C" or the "high C" arrangement. For greater flexibility in parallel coupler adjustment, leads have been provided for clipping to the coil turns. The coil turns that provide the best loading should be used, and the number of turns on each side of the coil center should be equal to provide feeder balance. For series use the clips are not used and can be fastened back out of the way.

In order to tune the coupler an SWR meter should be inserted in the line between the transmitter and the coupler and the coupler adjusted for the lowest SWR ratio. In the absence of an SWR meter, the coupler can be adjusted for maximum power to the antenna by the use of an rf ammeter, field strength meter, or lamp bulb coupled to the feeder.

If the antenna is used for receiving as well as for transmitting and the send-receive relay is located between the transmitter and the coupler, a bonus feature can be realized. When the coupler is properly tuned for transmitting on a particular frequency the strength of the received signal is greatly increased. In fact, it is possible to tune the coupler merely by tuning for maximum signal strength in the receiver, or for maximum S meter reading.

In using the combination coupler it should be possible to find one of the three tuning arrangements that will operate satisfactorily with almost any of the popular antennas, including the all-band type. The use of a coupler will go a long way toward providing more efficient operation and greater peace of mind for the amateur.

For a down to earth discussion on wire antennas, feeders and couplers, the reader is referred to the excellent articles by Richard M. Smith W1FTX which appeared in the July and August, 1952 issues of QST Magazine.

. . . W3WPV

Parts List

C1, C2—100 mmf variable condensers
L1, L2—Plug-in coils with links, as follows:
For power to 75 watts 15 meters—B&W JVL-15
20 meters—B&W JVL-20
40 meters—B&W JVL-40
80 meters—B&W JVL-80
For power above 75 watts 15 meters—B&W BVL-15
20 meters—B&W BVL-20
40 meters—B&W BVL-40
80 meters—B&W BVL-80
(Fixed link coils, JCL and BCL, can also be used)
6—through-panel insulators
4—stand-off insulators (for mounting condensers)
2 copper links
1—co-ax box connector
2—Pee Wee coil clips
1—5-pin coil socket
Miscellaneous hardware—fiber gears, shaft, etc.
1—5" x 9½" x 2" aluminum chassis

$5 Vertical

Clarence Wager K6TBW

There's nothing particularly exciting about a vertical antenna, what with beer-can verticals, drainpipe verticals, ad infinitum, but most of the verticals which seem practical also seem to involve considerable expense. Here is a vertical antenna which won't cost you more than five bucks or so, and may cost almost nothing, depending on what you have in your junkbox.

The materials needed are simply six strain insulators, about 90 feet of wire, and a hunk of coax. The coax is the only item which is very expensive. To construct the antenna all you need is a tree with a limb handy about thirty feet above the ground. Cut three lengths of wire about thirty feet long, fasten insulators to each end, and hang them from the limb. Space the wires about a foot apart. The insulators on the bottom ends of the wires are secured to stakes driven into the ground, also spaced one foot. The three strands of wire are shorted out at top and bottom with three foot pieces of wire. The ground system is a simple ground rod driven as far into the ground as possible. The antenna is fed with either 50 or 72 ohm coax. RG-59/U works fine.

That's all there is to it. If you want to be fancy you can use radials, but the antenna works OK without them. The best part of all is that the antenna, although designed for 7 mc, also loads with no trouble on 14 and 21 mc, and hits the low end of the 3.5 mc band too. By actual scientific tests the SWR seems to be fairly good everywhere (we didn't get bitten when we touched the key). On 3.5 mc the antenna isn't as good as a dipole, of course, but seems to do the business. Since the author runs CW nearly exclusively, we didn't try trimming the antenna for the phone bands, but naturally this could be done by anyone with the time and a few feet more wire.

For the guy who feels like improving things there are a few points we might mention. Metal tent pegs might be best for securing the bottom of the antenna. You have to watch for roots, and metal pegs would probably penetrate better than wood. In the antenna described number 16 stranded wire was used, but larger diameter wire would probably be better from both electrical and mechanical standpoints. . . . K6TBW

the

MINUTE MOTOR

Fred Herr W3WPV
911 Old Manoa Road
Havertown, Pa.

Would you like to know how much time you spent on the construction of a piece of radio equipment? With the use of the easily made device described in this article you can have a record of time spent on any project. The device consists of a motor driven counter that keeps an accurate count of the elapsed hours and minutes spent on your construction project.

In almost all types of construction and fabrication a knowledge of time consumed serves as a basis of cost analysis and is of great importance to all concerned. This is not exactly true in the case of home constructed equipment as the cost of time consumed is not important, being charged, usually, to enjoyment, education and relaxation.

Amateur radio is a hobby with many types of adherents, and it is believed that the amateur who prefers to build all or part of his equipment is in the majority. Amateur radio, in fact, owes its existence to the experimentally inclined pioneer who had to build his own equipment because commercially made equipment was not available at the time. With a large percentage of amateur radio equipment presently available in kit form, more and more hams are turning to this form of construction to acquire much needed gear at an appreciable saving in cost. When a prospective buyer contemplates the purchase of a piece of equipment in kit form, his first question will probably be —"How long will it take me to assemble and wire that kit?" After a kit is assembled and completed the constructor is always asked how many hours were required to do the job.

Whether the task is easy or of long duration it is of great personal satisfaction to know how much time was consumed on a project. During the construction period a "time consumed" record can be kept by a written notation indicating the time of starting and stopping each work session. Upon completion the total time used can be determined by totalling the sessions. This method is alright but could become quite tedious on a large project where many work sessions and interruptions might be involved. The use of a time clock or an elapsed time meter would be ideal but the cost of such equipment would probably exceed the cost of the equipment being assembled.

After using the pencil method on several projects it was given up as a bad job, as quite often the starting time or the stopping time would be forgotten, or allowance for frequent interruptions would not be recorded. In order to find a more accurate method of time recording the junk box was resorted to and gave up the parts that were assembled into the Minute Motor. The parts consist of a Haydon synchronous time motor and a Veeder counter, both of which are available on the surplus market at very reasonable prices.

The construction of the Minute Motor is very simple and can be accomplished in an hour or so. The motor and counter are mounted on a small base or chassis along with a flush mounted 115 vac receptacle. The shaft of the motor is fitted with a small lever which is drilled and tapped for a small machine screw to hold it in place on the shaft. The other end of the lever is drilled to take a connecting rod, which, in turn, is connected to the reciprocating lever of the counter. In operation, one full revolution of the motor will advance the counter one number. The length of the motor lever is rather critical and should be sized so as to advance the counter one number only for each motor revolution.

Compared to the usual radio circuit the wiring diagram of the Minute Motor is a joy to behold and can be completed with a couple of passes of the soldering iron. As shown in Fig. 1, the motor and the 115 vac receptacle are wired in parallel and connected to an extension cord of suitable length. Care should be used in insulating the connections in order to avoid accidental contact with the 115 vac circuit.

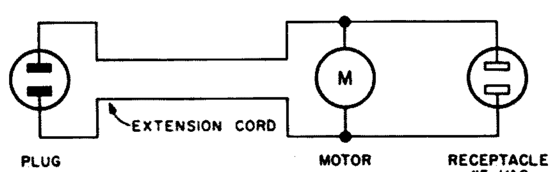

FIGURE 1

No dimensional information is given here because the component parts of the Minute Motor are made in a great number of sizes and shapes. The size of the chassis and the arrangement of parts will also depend on the size of motor and timer used. The manner of connecting the counter to the motor may have to be changed from that described herein as

(after watering, turn page)

some counters operate with a reciprocating action while others operate with a rotary action.

In use, the bench light or a drop light under which the equipment is to be constructed is plugged into the outlet receptacle on the Minute Motor and left there for the duration of the construction period. At the start of each work session the cord of the Minute Motor is plugged into the 115 vac source. During the time the cord of the Minute Motor is plugged into the 115 vac source the bench light will be on and the counter will be registering the number of revolutions of the motor. Although not used on the original Minute Motor, a toggle switch could be wired into the circuit which would eliminate the necessity of inserting and removing the plug for each work session.

At the start of a project a record is made of the number appearing in the window of the counter and this number when subtracted from the number appearing at the finish of the project will give the total number of motor revolutions made during the project. Of course, for the counter to tell a true story, the bench light which is plugged into the Minute Motor cannot be used for other purposes, and the Minute Motor, itself, must be unplugged when no work is being done on the project.

The Haydon timing motors, or similar motors of other makes are made with various speed outputs, from one revolution per fraction of a minute to one revolution per day and even slower. The motor used in the Minute Motor has a speed of one RPM, and in use, an increase of one number on the counter represents one minute of elapsed time. At the start of a project a record is made of the number appearing on the counter. This number subtracted from the number appearing at the finish of the project represents the total elapsed time in minutes, which, in turn, divided by 60 will give the time in hours and minutes.

The Minute Motor was first used on the assembly of a well known transmitter kit. The counter showed the number 1633 at the start of the work and the number 3628 at the finish. 3628 minus 1633 equals 1995 motor revolutions, or 1995 minutes. This divided by 60 is equal to 33.25 or 33 hours and 15 minutes total construction time. The latest project, the assembly of a ten-meter transceiver kit, using the Minute Motor, required a total of 17 hours and 13 minutes to complete.

The ideal motor for the Minute Motor is one having an output speed of one RPM, but motors with other output speeds are equally suitable and only require one additional step in the computation of total elapsed time. If a

4 RPM motor is used each revolution would advance the counter one number which would represent only a quarter of a minute. To obtain the true elapsed time in minutes the total counter number would have to be divided by four. In the case of a 6 RPM motor, the total counter number would have to be divided by six.

As the counter ordinarily available will return to zero when its highest number is reached it is best to use one with at least four digits displayed in its window in order to avoid going through the zero point more than once on a project. A counter that could be manually reset to zero at the start of each project would be ideal.

The ham constructing and using the Minute Motor will be rewarded with the satisfying knowledge of the exact time required for completion of a project and will not have to rely on a wild guess when questioned by his fellow hams.

In addition to the Minute Motor's use as a construction project timer, it can be used in the power circuit of a piece of equipment to record the total operating time of the equipment. Its use as a time recorder is limited only by the imagination. . . . W3WPV

F.T.C.

Filament Transformer Conversion

Floyd O'Kelly W5VOH
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Midland, Texas

Are you having trouble finding a suitable filament transformer at what you may consider a reasonable figure for that new final rf amplifier you are building? Offered here is a method of exchanging your time and effort for such a transformer at a very modest cost.

The problem can be resolved in three parts:

1. Determine the wattage requirements for the filament or filaments of the tubes to be used in the amplifier.
2. Find a transformer capable of supplying wattage.
3. Modify and rewind the transformer to supply the proper voltage and current.

As an example of the solution of part one: We plan to construct an rf amplifier using four 811A's. The filament in each 811A requires 4 amps at 6.3 volts. The filament wattage per tube will be 4.0 (amps) x 6.3 (volts) = 25.2 watts. Four tubes will require four times this wattage - 4 (tubes) x 25.2 (watts per tube) = 100.8 watts. Therefore any transformer used to supply the filaments should have a minimum rating of 100.8 watts for continuous service.

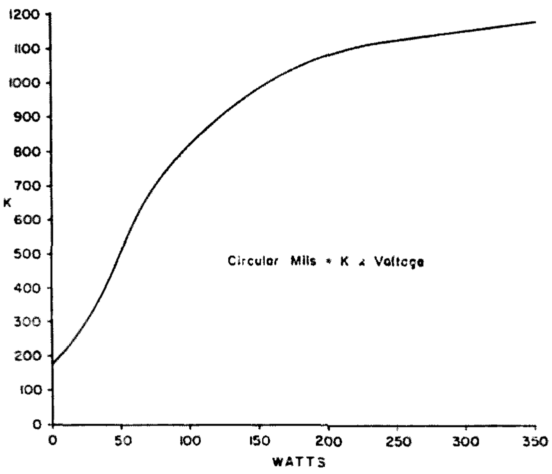
The second problem can be solved by visiting your favorite TV dealer or repair man to find out what junked TV sets with power transformers are available for bargaining. You should be able to pick up the transformer alone for a buck or less if you remove it from the old TV chassis. If the repair man does your TV servicing or the dealer has sold you some merchandise recently he may give you the complete set.

After you have acquired an old TV power transformer—or before, if you are given a choice of several sets—it is necessary to determine if the transformer has the wattage requirements to handle your tubes. As a first try, look up the manufacturer's specifications on the junker you have selected to determine if its power input requirements (wattage) are equal to or greater than the wattage requirements for the filaments of the tube you plan to use. If it meets this specification you may have found your transformer. If you are unable to find the manufacturer's specifications, look up the set in a Sams or Rider Photo Facts, and in the parts list you should find the wattage of your transformer. Most radio and TV shops have a Radio Master Catalog that may enable you to find your information if only the manufacturer's part number is on the transformer. If no information concerning the transformer you have selected can be found, it depends on how much of a gambler you are whether you wish to use it or not. It is advisable to select one with a known rating.

After a selection is made, check it over for shorts and that old tattle tale burned smell. Carefully separate all the secondary leads and connect the primary to a fused 117v outlet. If it blows a fuse it may or may not be any good. However, as the primary is all that needs to be good, proceed with caution if it blew the fuse.

Assuming the primary has tested good, we can proceed to the third part. The modification may also be broken down into parts: 1. Factors that must be known: the voltage and current required from the secondary. 2. The numbers of turns of wire to supply the voltage required. 3. The size of the wire required to carry the filament current. 4. The actual rewinding.

The voltage and current requirements for the tube or tubes can be found in the spec sheet on the tube or the ARRL Handbook. The number of turns of wire to be used on the secondary can easily be found by using the following advanced mathematical gyrations. Count the number of turns on the transformer that are used on the six volt and/or five volt winding and divide the number of turns by their respective voltages. The resultant is the turns per volt for that particular transformer.



The manufacturer has probably done a good job in obtaining this figure, so take his word for it. All that is necessary to do now is to multiply your desired voltage by the turns per volt ratio, and presto the total number of turns for the secondary are found.

Now for the bug-a-boo that seems to rip everyone up . . . what SIZE wire to use. The current carrying capacity of a wire is directly proportional to its cross-sectional area, however, conditions under which the wire functions will add a multiplier to this statement so that no hard fast rule can be made that guarantees that a wire size will carry so many amperes. The reason for this is predicated upon the wire's ability to dissipate generated heat under its operating conditions. For example, you would expect a wire in open air (such as a utility line) to dissipate its heat better than the same size wire (with length the same) coiled and encased in a transformer. Therefore, a larger wire will have to be used in a transformer than one used in open air conditions to carry the same voltage and current. The size wire to be used is determined by the wattage and type of operations. By referring to Fig. 1, a value K can be determined for the particular wattage that the transformer is to handle. This value K multiplied by the filament voltage is equal to the necessary circular mils value of the wire to be used. For example—let's use the four 811A's again—they required 6.3 volts and 100.8 watts. Looking on the chart we find one hundred watts, go up to the curve and across to a K value of about 820. Multiply 820 x 6.3 = 5166.0 circular mils. From the wire tables we find that #14 solid copper wire has a circular mil cross section of 4107.0 and #13 has 5178.0. Size #13 is almost on the nose, however it has been found that most motor rewind shops only stock even sizes of wire, so it may be necessary to go to the next even size larger or in this case #12. Size #12 wire has a cross sectional area of 6530.0 circular mils and would probably operate slightly cooler. (It must be remembered that the larger the wire, the smaller the number of the wire.) A good grade of enameled copper wire, such as used in motor rewinding, is recommended.

Now that all of the paper work is over we can get down to the rewinding job. Many manufacturers place the secondary winding on last, or on the outside, making it a simple matter to cut through the secondary layers with a hack saw and remove them in a short time. Be careful and avoid cutting into the primary unless you plan to rewind it too. After the secondary is removed, place about three layers of plastic electrical tape over the primary windings if you don't have access to transformer varnish paper. It is now only a simple matter to fish the required number of turns through the transformer windows (this procedure is recommended if only the filament secondary is to be rewound). Be careful not to scrape the enamel from the wire on the sharp edge of the transformer's core—and pull them tight. Leave the leads long—you can always cut them off later.

There are two schools of thought on obtaining the secondary center tap: 1. Count the number of turns, divide by two, and tap on to the wire; 2. Wind two secondaries with each equal to one half the required voltage. I prefer the latter, as you can easily be assured of a correct center tap. (If this method is used, be careful to wind both secondaries in the same direction.)

Check your work, and if it meets with your approval connect the primary to the power line and measure the secondary voltage. It will probably be higher than calculated, but you can expect it to drop when the tubes place a load on it. If the voltage is within 10-15% of the calculated value, connect the tubes to the transformer and check the voltage under load. If the voltage is too low, add a half turn or so until the voltage is correct. The reverse would be true if the voltage is too high. This should not be necessary if the above procedure was properly followed.

Place enough plastic tape over the winding to hold it firmly in place, and the job is finished. If there is a case for the transformer, slip a good grade of spaghetti over each of the protruding wires.

I believe you'll find that this "poor-boy" transformer will not take a back seat to any of the commercial grades and you can't buy the experience you will have gained in rewinding it! Good Luck!

. . . W5VOH

(QLF from page 29)

a Colonel should be addressed, and with a meek, "Yes, Dad," left the Texas station hanging in mid-air and *Pulled The Big Switch*, and *Hit the Sack*. Kids, just don't act that way now, or perhaps it's because I never got above a Second Louie . . .

And will I ever forget the thrill of flying my own plane and at the same time hamming on 5 meters? But by that time there was such a thing as a "store-bought" xmtr rig. So it wasn't too difficult, except that three of us pilot-hams had built everything from scratch and it did work. 50 watts from the plane at 1500 feet, got us *some 5 mile DX!* Today the same 50 watts on 6 gets around the world in a good deal less than 80 milliseconds!

One of the newer deals that really gets my cork out is the gink who "breaks" your qso with some friend with a lot of queer-sounding gibberish supposed to sound like a foreign language. When you say, "breaker identify yourself" you get more of the gibberish with something that sounds like "YK1 ADC calling," etc. And no amount of talk will induce the nut to get back to English or whatever could pass for any known language. This type of idiot should have his license yanked, his tower destroyed and he should be made to send ICW to himself for the rest of his life, "I am a nut" . . .

You can count yourself with a high IQ if you know that: A concerted move is being made by the CB'ers to have at least 6 channels set aside of their bands for frank and open hamming. They call it the pre-ham or sub-ham bands. This will be the first inroad into hamdon where *NO operators' licenses will be required!* They feel that with 250,000 prospective "votes" the FCC cannot say them nay. Also there is a move on foot to get the CB'ers to use SSB!

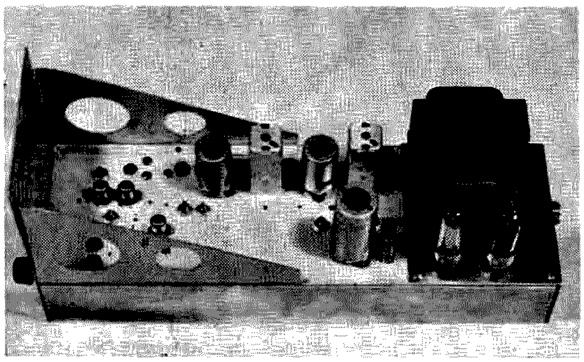
You are really smart if you have heard the move on foot by some manufacturers to obtain a permit for the use of 4000 watts PEP by the hams. They are after an FCC interpretation which would permit this, as if there isn't enough power in the ham bands right now. And you can work out only if you stay out of "Kilowatt Row" on the usual 80-40 and 20-meter bands . . .

QLF (a term born over 50 years ago with spark) stands for "Send with your left foot, you lug!" . . . K9AQJ

144mc Nuvistor Converter

John Wonsowicz W9DUT
4227 N. Oriole Ave.
Norridge 34, Illinois

Photos by: Howie Trieb K9EPB



Top view of the complete unit showing the converter and the power supply module. The crystal oscillator and trippler tube can be seen in the lower left. The if output is directly above the crystal, next to the second if can.

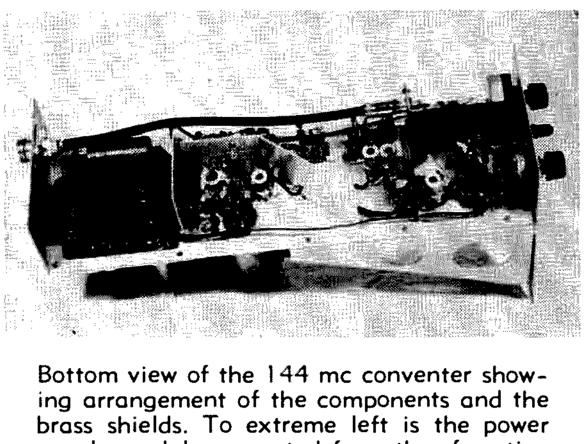
It seems that more and more manufacturers of electronic devices and a large number of VHF gear home-brewers are taking a shine to circuits using the 6CW4 or similar nuvistors. From data previously published on the excellent performance of this pip-squeak, it's a wonder that the "large-tube" counterpart is still surviving. Of course we can always find room for the big brother, but for pre-amps, converters and VHF front ends, the thimble is it.

The converter about to be described is the outgrowth of the nuvistor pre-amp published in the March 1963 issue of this magazine which received such wide acceptance, as indicated by the large amount of mail.

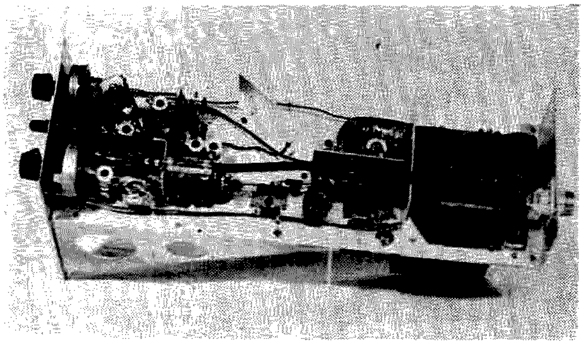
This device, which combines the high gain, low noise pre-amp with a crystal controlled converter and a stage of *if* for extra gain, was designed and built as a plug-in unit for a deluxe VHF communication receiver now in process of construction. However, the converter can be used with any 6 meter receiver or fed into any 50 mc converter that uses a lower frequency receiver for tuning. The project is not too complicated for an average do-it-yourself man handy with a soldering iron and requires only a few evenings of time to put it in orbit with guaranteed satisfaction.

Performance

Evaluation of performance on the points of sensitivity, noise figure, gain and bandwidth is as follows: The sensitivity when coupled to an average receiver will be in the order of .1 to .2 microvolts. The noise figure is 3 to 4 db. Gain is at least 50 db. Bandwidth is within 1 db at 148 mc when peaked at 145 mc. Due to a stage of 50 mc *if* built into this unit, the converter can be used with low gain, poor



Bottom view of the 144 mc conventer showing arrangement of the components and the brass shields. To extreme left is the power supply module separated from the rf section by the angled T that houses the oscillator and trippler. The larger coil is the oscillator coil and the smaller diameter coil is the trippler. The link coupling connected by the twisted lead runs through the angled shield to the mixer coil. Adjacent to the mixer coil is the plate coil of the 6CW4, and to its lower right is the cathode coil of the same nuvistor.



Bottom view showing the rf gain control and the input cathode coil compartment. The NE 2 switch bulb can be seen just above the cathode coli. The ceramic CI capacitor is fastened to the chassis by two ¼" spacers and 4-40 screws and nuts. Coil just above the NE 2 is the plate coil of the tandem nuvistors of the first rf stage. The angled shield separates it from the cathode coil of the next stage.

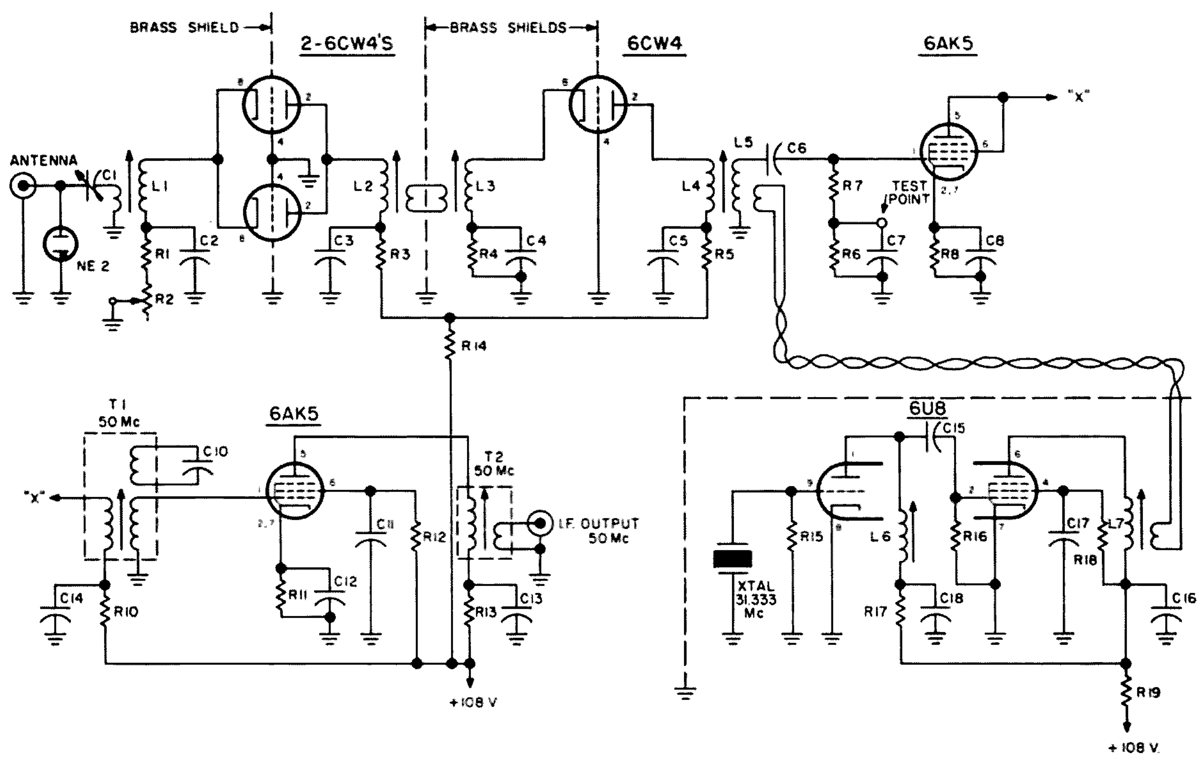
sensitivity receivers with excellent results. In fact, on most of the local signals the rf gain control must be retarded to eliminate overing.

Construction

To start the project, a piece of 1/16" thick aluminum 4 inches wide and 14½ inches long is shaped as shown on the bottom photo. This is used as the chassis which is placed over a shield box that is shaped and fitted to it. In as much as this type of construction requires special tools, a standard Bud Chassis no. AC432 which measures 3" x 17" x 4" can be used. However, use the chassis as the shield only and fasten the bottom aluminum plate to it for drilling and mechanical aligning and then use the plate as the converter chassis. It is much easier to wire components and fit the brass partition coil shields on a plate chassis than the standard 3" deep chassis and it looks as good.

Arrange the rf components on the front part of the plate, as shown on the photos, bearing in mind the space necessary for the brass partitions which are shaped as an L and fastened by 2-56 screws to the aluminum chassis plate. Upon completion of the wiring, the brass shields can be tack-soldered for better ground connection.

After the layout of the nuvistor sockets and the brass partitions, allow the necessary room for the J. W. Miller *if* transformers. To make the cut-outs, use the steel templates that Miller furnishes with each transformer for drilling and filing of the slots. You will find it quite easy to do if you secure the steel template to the chassis plate and do the drilling and filing through the template. T1 and T2 are the Miller transformers and bear the numbers 6233 and 6231 respectively. The 6233 is a TV 45.5 mc transformer with a 47.25 mc trap and the 6231 is a 44 mc TV *if* transformer with a low impedance output coil. Both of these transformers are slightly modified by removing 3 turns from the coils to get them to tune to 50 mc. In the



144 Mc. NUVISTOR CONVERTER

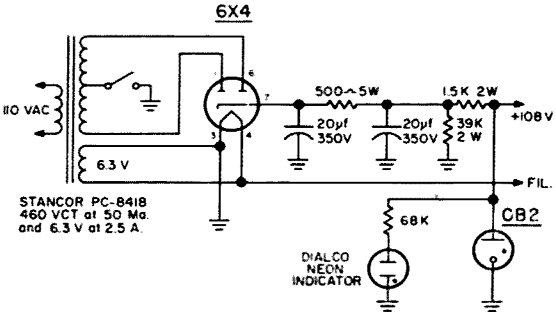
6233 transformer, the 47.25 mc trap can be utilized by shunting it with a 50 mmfd capacitor to trap out the third overtone crystal frequency of the converter oscillator from feeding through and giving false beats.

In the unit shown, a cut-out of 3½" x 3" was made to accommodate the power supply module. Although such construction is ideal if you have the extra time, it is not essential to performance of this unit. The power supply can be built on the rear part of the chassis plate with or without the OB2 regulator tube.

The bottom view of the photo shows the wide separation between the rf and mixer coils and the oscillator coils. This is good practice since the only injection to the mixer is through the link coupling, thereby eliminating capacity pickup of spurious beats.

The neon lite shunting the antenna is a simple electronic switch which shorts out the input to the converter in case of excessive rf in the antenna relay during transmission periods. It also discharges the build-up static in the antenna during storms.

The front panel and associated components



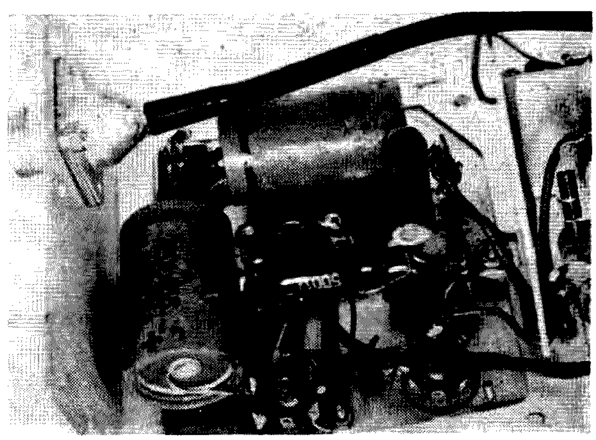
POWER SUPPLY FOR 144 Mc NUVISTOR CONVERTER

can be left out. In this unit they are a part of a plug-in module of a receiver and constructed to add rigidity to this module.

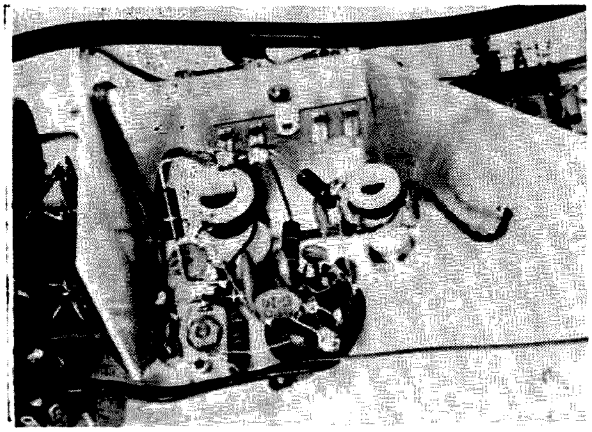
Electrical

The modification of rf ceramic coils which carry a Miller no. 41A000CBI was detailed in the March issue article on "Nuvistor Pre-amp." I might add that J. W. Miller furnishes several extra wire tabs with each coil at no extra charge, making such modifications easier.

If you follow the schematic wiring diagram and make up the coils as per coil data, no trouble will be encountered in the final peaking. The rest of the wiring is rather simple. With the aid of a small soldering iron, connections to the 6CW4 sockets and the link coupling tabs should be easy. The necessary pre-



Bottom view of the power supply module showing arrangement of components. The coax connector is placed from inside so that a proper length of RG/58 U can be fashioned on the bench before installing.



Oscillator compartment showing arrangement of components. By-pass capacitor leads are as short as practical for arrangement and soldering.

caution to take in all VHF items is very close by-passing. Cut the lead of the by-pass capacitor as close as possible and return it to the brass shield. Use a bigger soldering iron when soldering to the shield.

After all soldering is completed, take a few minutes and check over all connections for cold solder joints and at the same time check the wiring against the schematic. With this out of the way, start the tuning of the unit.

Tuning

The tuning of the converter is performed in a way ordinarily used in aligning pre-amps and converters. For those that have never attempted to set their converter to the proper portion of the band, proceed with the simplest of all methods—the grid dipper. First, dip all your coils in the rf section to the proper frequencies. L1 through L5 are dipped at 144 mc. L6 is dipped to the crystal frequency of 31.333 mc and L7 is dipped to the third harmonic of this frequency, making it resonant at 94 mc. These coils can be dipped and pruned before completion, but with the tubes in place and no power applied. To eliminate false frequency dipping, a good practice to follow is to ground all the coils first with a jumper wire, then disconnect the jumper on the coil to be dipped and set it to frequency with the slug. When the right frequency is reached, ground the coil again and then follow through for the rest of the coils in similar manner. Don't forget to disconnect all the jumpers when dipping is completed.

The modified Miller transformers no. 6233 and 6231 will be close enough to 50 mc with the removed turns on the coils, so nothing is done to them until the final touch-up.

After the front end is dipped and the unit completely wired, connect it to the antenna and a 50 mc receiver or converter and proceed with the final adjustments with power applied.

Tune in a station or use your grid dipper as a signal and adjust the 50 mc *if* for highest gain. Next, touch up all tuned circuits for maximum gain except L1 and C1. These two components should be adjusted back and forth until the unit displays a minimum of background noise. At this point the signal will appear to be the cleanest, with only slight background hiss. In order to get the best bandwidth it is necessary to use a good signal generator and a VTVM or a sweep generator and an oscilloscope. However, most operators will be com-

Coil Data

L1—4T #26 Bare Space wound one wire diameter 3T Link on cold end.
L2 4T #26 Bare Space wound 3T Link on cold end
L3 4T #26 Bare Space wound 3T Link on cold end
L4 5T #26 Bare Space wound no link (close to L5)
L5 4T #26 Bare Space wound 3T Link on cold end
L6 6T #26 enamel close wound 3T Link on cold end
L7 8T #26 enamel close wound no link 3/8" coil form
All coil forms are J. W. Miller ceramic forms
L1 = through L6 are no. 41A000CBI
L7 = is No. 42A000CBI

I.F. Transformers

T1 is J. W. Miller No. 6233 TV 45.5 mc modified as per article for 50 mc operation
T2 is J. W. Miller 6231 TV 44 mc modified for 50 mc operation.

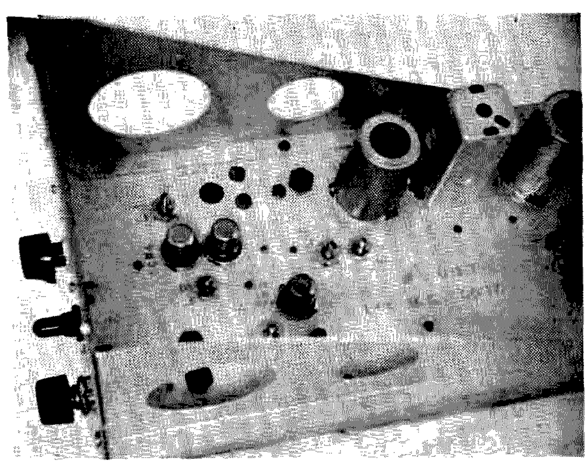
Capacitors

C1 = Ceramic Trimmer 7-45 mmf. Centralab 822-BN
C2, C3, C4, C5, C7, 8, 16, 17 = 470 mmf R.M.C. discaps

C6 = 33 mmf NPO RMC discap
C11, C12, C13, C14, C18 = 1000 mmf RMC Discaps
C10, C15 = 50 mmf NPO RMC Discap

Resistors

R1, R4, R8, R11 = 100 Ω ½ Watt
R2 = 5K W.W. POT
R3, R5, R10, R13, R17, R19 = 1000 Ω ½ W.
R12, R15, R18 = 47000 Ω ½ W.
R7, R16 = 470 K ½ W.
R6 = 100 K ½ W.
R14 = 10 K 1 W.
Note: C9 and R9 in the schematic have been eliminated.



Enlarged top view of the front end showing the arrangement of nuvistor and coils. The first large tube in the upper right is the 6AK5 mixer.

pletely satisfied with just peaking the converter in the 145 mc range and leaving it there. The attenuation of the signal will be only 1 db at 148 mc, and that's practically a flat response.

It is needless to say that a converter built as described will give you excellent service in all VHF departments, i.e. sensitivity, bandwidth, gain and low noise figure. But the only sure way to satisfy yourself is to compare it with other home-brew and commercial jobs and be the judge. You will grin a grin of pride and satisfaction.

The Portable HE-35

Charles Green W3IKH
17 Little Lane
Levittown, Pa.

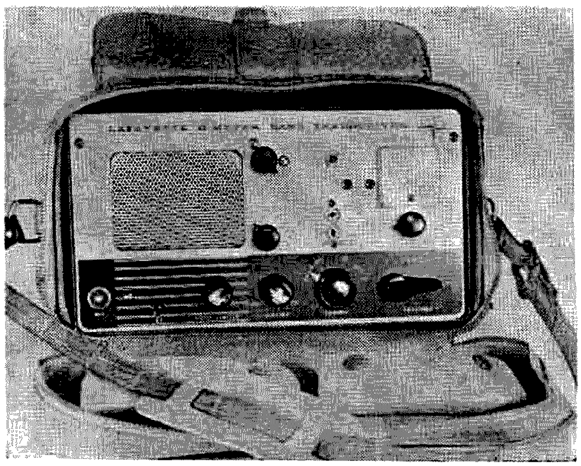


Fig. 1.

Now, those of you who are familiar with the HE-35 are looking at the front panel views of Fig. 1 and Fig. 2, and saying "There ain't no such animule." To those others who are not . . . the meter and the control knobs around it don't come with the HE-35.

To explain . . .

My vocation requires frequent traveling and my avocation is hamming. After many evenings in dreary hotels away from home and the ham shack, the thought of a portable rig seemed like a way to combine both my avocation and vocation.

Since most of my traveling is by air, the rig had to be both small and lightweight. Also one of the higher frequency ham bands had to be used, because of antenna space limitations in a hotel room.

The Lafayette HE-35 filled my requirements. It is small (10⅝" L x 5" H x 6¾" D) and lightweight (11lbs.). I also found that I would fit into a photographic gadget bag (Fig. 1), with room for xtals and other things in the pockets. It also seemed like an inconspicuous way to carry a transceiver into a hotel.

After purchasing the HE-35, I realized that a field strength meter was also needed for tuning up. Since this would require more space and weight if separate, I decided to put a panel mounted plate current meter into the rig for tuning up the transmitter.

The Lafayette TM-403, a 100 mil. panel meter, matched the front panel very well. I removed the pilot lamp on the upper right part of the front panel. Then, using a fly-cutter, I mounted the meter. I also removed the phono jack used as a mike input and mounted a standard Amphenol 75-PC1M chassis connector instead.

The Rubicon had been crossed, there was now no turning back. Once I had started modifying the HE-35, I couldn't stop . . .

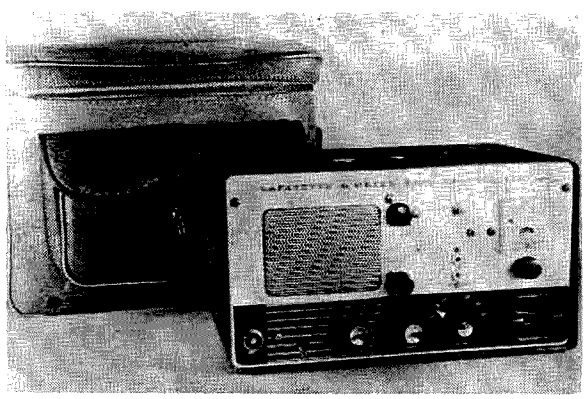


Fig. 2.

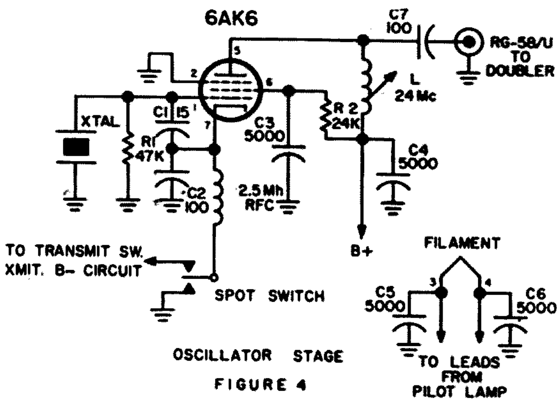
The overtone xtal oscillator circuit was next. I preferred to use 8 mc rocks instead of the more expensive overtone variety.

The pilot light that was removed when the plate current meter was installed used a #47 lamp. The #47 lamp draws .15 amps and is part of the series-parallel heater circuit (Fig. 3). In order to keep the heater circuits balanced, I used a 6AK6, which draws .15 amps of heater current, for the 8 mc oscillator tube.

The oscillator stage (Fig. 4) was built on a small piece of aluminum and fastened to the front panel, alongside the panel meter, with two phillips head machine screws as in Fig. 5 and Fig. 6. Heater connections were made to a terminal strip, mounted just below the panel meter (Fig. 6), to which the former pilot lamp leads had been connected.

An xtal socket for the FT-243 8 mc crystals was mounted in place of the former overtone xtal socket. Also, a spot switch, of the push type, momentary contact, spdt variety (Lafayette MS-449) was mounted on the front panel above the xtal oscillator chassis (Fig. 4).

A grid dip meter was used to resonate the oscillator plate coil to aproximately 24 mc, with the tubes inserted and the RG-58 lead con-



OSCILLATOR STAGE

FIGURE 4

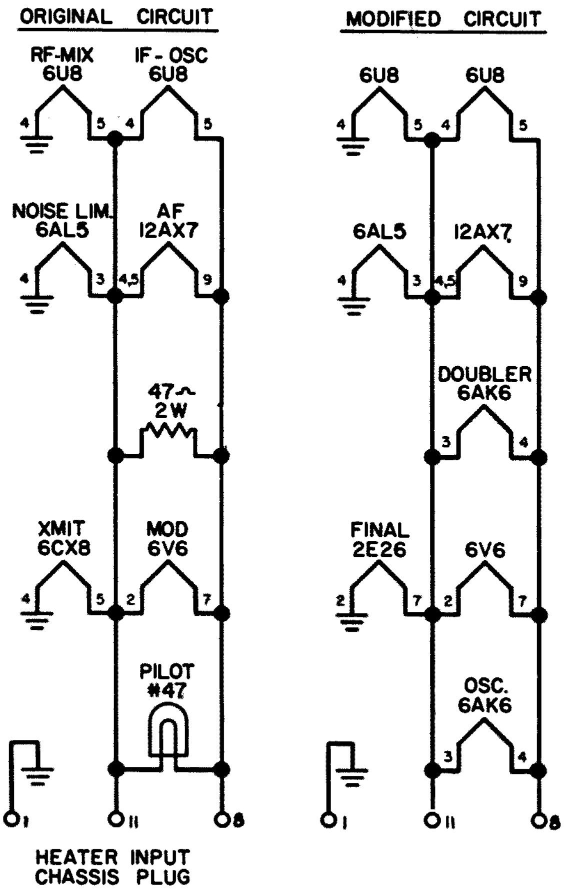
Note: L—approximately 19 turns #26 enamel wire on ¼" dia. variable iron core coil form.

nected to the triode section of the original 6CX8 tube (which acted as a doubler stage.). Note: the coil data given in Fig. 4 is for the modified doubler stage of Fig. 7.

Naturally I wanted front panel controls instead of the screwdriver adjust type ones mounted on the chassis. This was my downfall. If I only had known the trials and tribulations that lay ahead, as the old refrain goes.

I cleverly calculated that if the same values of components were used as in the original circuit, the substitution of panel mounted air variables for the original types of capacitors should work. But I forgot about the old devil Lead Length. The 6CX8 went into business for itself. The circuit oscillated merrily and I could not neutralize it.

Having always been suspicious of the use of single ended tubes at high frequencies, with the plate connecting pin rubbing shoulders with the other common tube pins, I thought of the possibility of substituting another tube with a plate cap for shorter connections to the panel mounted variable capacitors. Unfortun-



HEATER CIRCUIT

FIGURE 3

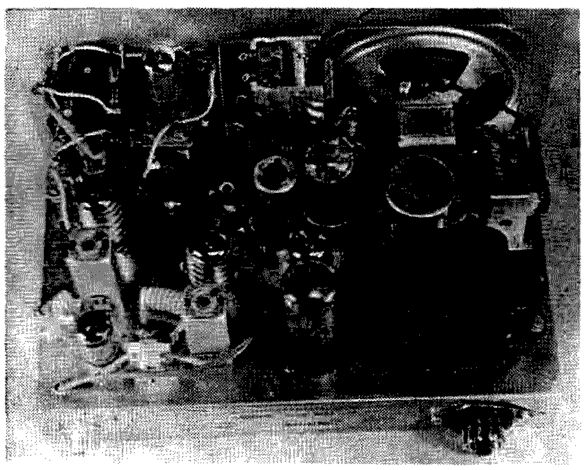


Fig. 5.

ately a triode-pentode similar to the 6CX8 with a plate cap did not exist. So I had to make two tubes grow where only one had existed before Also the heater currents had to fit in with the master plan (Fig. 3).

I used another 6AK6 as a doubler and a 2E26 for the final. By removing the 47 ohm resistor the heater circuit seemed to balance out pretty well. (Modified circuit of Fig. 3)

With the 6CX8 socket and plate circuit wiring removed and a little fancy work with chassis socket punches, a 7 pin JAN shielded type socket for the 6AK6 and a ceramic octal socket for the 2E26 just squeezed in. The original rf choke was remounted on an insulated solder lug terminal vertically alongside the 2E26 (Fig. 5). The plate tank coil was mounted on a terminal strip close to the plate tuning capacitor. RG-58 was used to run the output from the link secondary winding to the antenna switch section of the relay (Fig. 7).

Fig. 7 is the schematic for the doubler and final circuits. A shielded pair of wires connect the panel meter to the final plate current connections at the rf choke. They pass under the aluminum shield which isolates the final tank coil from the oscillator stage.

The neon lamp originally used as a front panel rf indicator was rewired as in Fig. 7 to serve as a modulator output indicator.

The doubler plate coil (LI, Fig. 7) was resonated at 50 mc with a grid dip meter. All tubes were inserted in their sockets and the power off. Then the coil (LI) was repeaked for maximum output, with the circuit in opera-

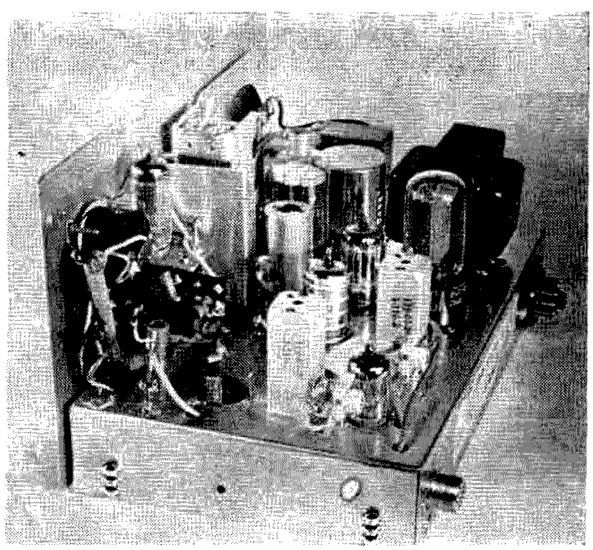
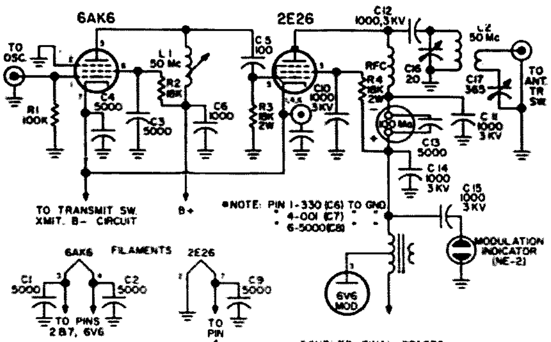


Fig. 6.



DOUBLER-FINAL STAGES
FIGURE 7

Notes: RFC—original component, C16-E.F. Johnson type 20M11, C17-Lafayette type MS-214, L1-ipprox. 7 turns #26 enam. 1/4" dia. variable iron core coil form, L2-(pri) 6 turns #12 1/2" dia. (sec.) 1 turn insulated wire.

tion, by using the grid dip meter as a detector, and adjusting for maximum reading.

The plate current of the 2E26 will dip to approximately 30 ma at full rf output to the antenna. This is below the normal rated current of 50 ma for the 2E26, but due to the low B+ available it seems to work beter at 30 ma. The 6CX8 also resonated at 30 ma of plate current, so the power input remains about the same.

The receiver was also modified. A small variable capacitor (Johnson 9M11, 9 mmfd) was mounted on the front panel under the plate meter. This allowed a short lead to the grid terminal connection of the antenna coil. By removing the 4700 ohm shunting resistor connected across the coil, the variable capacitor acts as an antenna trimmer capacitor. Weak signals can be peaked up considerably and the front end selectivity is much better.

Both the transmitting and receiving antenna traps were disconnected. This seemed to improve both transmission and reception. While

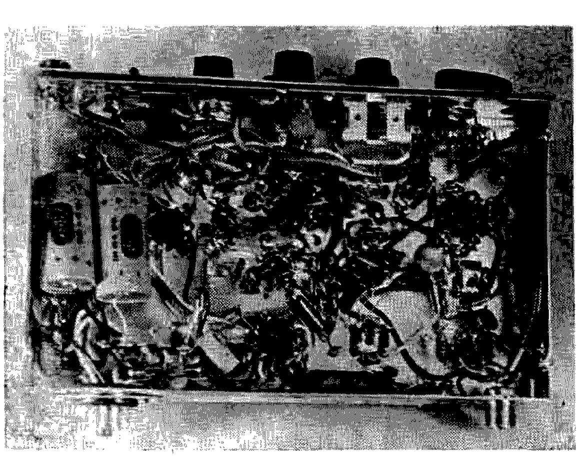
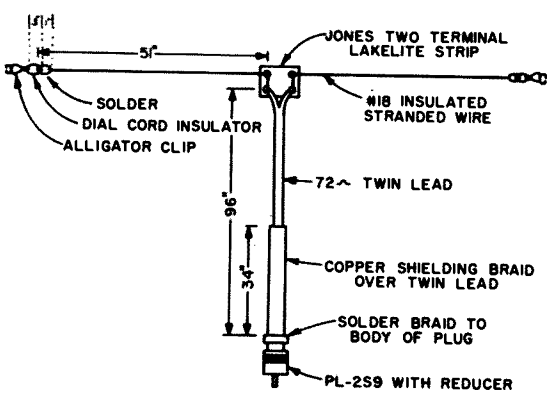


Fig. 8.

receiving weak signals with the gain turned near maximum, I noticed that as I varied the audio control, the receiver detuned. This was traced to inductive pickup from an unshielded wire lead from the transmit switch to the audio gain control. This passed near the solder lug terminal strip to which the receiver tuning capacitor was connected with a 15 mmfd disc capacitor. By replacing the lead to the audio gain control wih a shielded wire, the trouble disappeared.

A pointer of white plastic was cemented to the receiver tuning outer knob and approximate calibrations were scratched between 50 and 51 on the panel dial. After the receiver warms up for a while, the tuning becomes fairly stable.



PORTABLE 6M ANTENNA
FIGURE 9

A portable 6 meter antenna was made as in Fig. 9. The alligator clips connected to the antenna ends by the dial cord insulators enabled me to set it up almost any place. A piece of copper shielding braid is slipped over the 72 ohm twin lead as shown (34") and soldered to the coax plug to act as an unbalanced to balanced rf line transformer.

I have used the rig for some time and it has worked very well for portable operation and also for fixed station at the home QTH.

. . . W3IKH

5/7/9 Magazine?

Yep, we're starting still another little publication. This one is for the contest type operator and will list all of the contests scheduled for the next two months. It will also give the rules and present the results of contests which do not get full coverage in QST or CQ. This should also be helpful to ops working on certificates. $2 a year, published monthly. Use subscription form on page 93 or just send money and info. Clubs running contests are requested to furnish 73 with rules and results of their contests for publication in 5/7/9.

BUYERS GUIDE

W2NSD/1

Perhaps I am unusual in that when I develop an interest in some piece of ham gear I rush to my magazines and try to find an ad or other information on that particular unit. This can be very frustrating. Chances are that the manufacturer has something else that he is excited about at the time and I have to look back for maybe a year or so trying to find information. Or else I may pull out two or three of the larger catalogs from ham equipment dealers, only to find that they apparently don't share my interest.

In order to provide one master listing of ham gear I decided to put together this section in 73. I've tried to include everything that I could get information on and put in all of the basic dope that you might want to know. If I've left out any products I'll expect to hear from you and perhaps we can run a supplement. If I've left out any crucial data please excuse me this time, I'll do better when we bring this up to date next year (*if* you like the idea).

The prices are current to the best of my knowledge, but don't be astounded if inflation gives them a bit of a boost.

Obviously I couldn't cover everything made for the ham market. In this list I've included transmitters, receivers, transceivers, power supplies, antenna tuners, some test equipment, and even a few accessories. I have in mind covering accessories more thoroughly in a couple of months and sometime next spring to compendiumize the antennas and associated equipment.

A good deal of this issue is taken up by our Buyers' Guide. I had hoped to be able to run more pages in this issue in order to have the usual number of articles, but my preoccupation with assembling the Guide kept me from hounding advertisers into submission, with the result that I couldn't run as many pages as I had hoped to. Oh well, enjoy the Guide. OK?

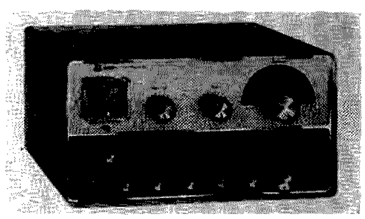
ALDEN

Alden Products Company
Brockton 73, Mass.

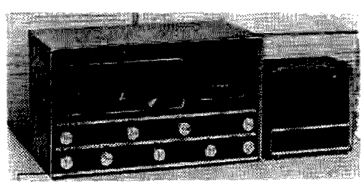
Alden Hambench. Steel construction, channeled to hold ac wires and control wiring. Top 26" x 60". Standard model has Masonite top, Deluxe model has Formica top 1¾" thick. Baked enamel finish. Standard Model: $99.95. Deluxe Model $139.95.

Knight

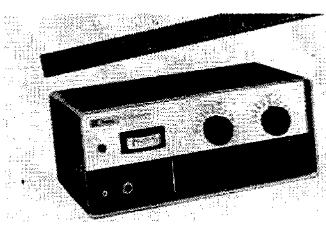
Allied Radio Corporation
100 N. Western Avenue,
Chicago 80, Ill.



150 watt transmitter kit. 80-10 meters, 150 watts input CW/AM-peak, 100 watts 6 meters. Controlled carrier screen modulation. Built-in VFO. Output pi net 40-600 ohms. 6146's output stage. 8½" x 17" x 10½" 28 lbs. TVI shielded. Power supply built in. T-150 Kit . . . $119.95.

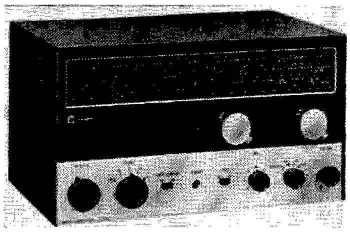


Continuous coverage receiver, 540 kc to 30 mc with a separate bandspread control for tuning 80-10 meters. Built-in Q-multiplier. Four tuning bands, printed circuit bandswitch and circuit boards. 7 tubes plus rectifier & voltage regulator. Exalted BFO for SSB, provision for built-in crystal calibrator, noise limiter. R-100A Kit . . $99.95. S-Meter Kit . . $12.95. Speaker Kit . . $9.95.

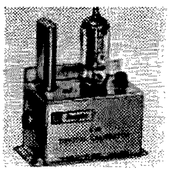


60 watt transmitter, 80-6 meters (slightly less input on 6), CW/AM-peak. Controlled carrier screen modulation. Pi net output 40-600 ohms. Built in power supply. Xtal or separate VFO required. 6DQ6B fi-

nal. RF meter for simple tuning. T-60 Kit . . . $49.95.



Continuous tuning receiver, 530 kc to 36 mc and 47 mc to 54 mc. Five tuning bands. Separate bandspread tuning on 80-6 meter ham bands. BFO, noise limiter, antenna trimmer, provision for built in crystal calibrator, built in speaker. 5 tubes plus rectifier. R-55 Kit . . . $59.95.

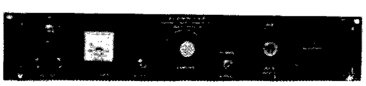


100 kc crystal calibrator kit. Gives marker every 100 kc up to about 35 mc. Trimmer for zero beating WWV. Builds into R-100 or R-55 receivers. Powered by receiver. X-10 Kit . . . $10.95.

Self powered VFO, 80-10 meters. Can be keyed directly for break-in operation. Clapp oscillator for high stability. Calibrated on all ham bands. Output on 80 & 40 meters. Power supply built in. V-44 Kit . . . $29.95.

Alltronics-Howard

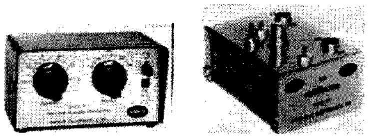
Alltronics-Howard Co.
Box 19
Boston 1, Massachusetts



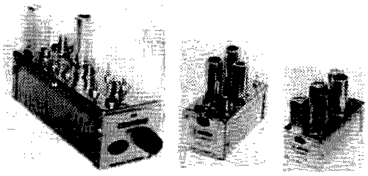
The Model K Telewriter converter features linear discriminator, dual eye indicator, separate magnet supply, front panel jacks, loop current meter. Size: 3½ h, 19 w rack panel. Price: $189.00, cabinet $14.00.

AMECO

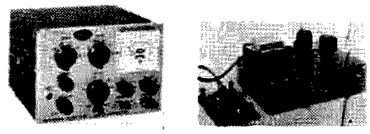
American Electronics Company
178 Herricks Road
Mineola, New York



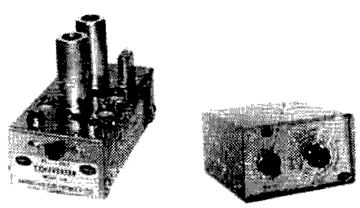
Preamplifier Model PCL (left) for all bands 80-6 meters. Nuvistors give 20 db gain. Nuvistor preamplifier for 50, 144 or 220 mc (right) Model PV. Both require power from receiver or from PS-1 power supply. PV . . . $13.95. PCL . . . $24.95.



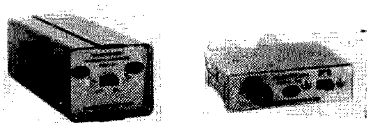
Converter (left) for one band 50-144-220 mc, two nuvistors, one 6J6. Any i-f output. No power built in. PS-1 power supply separate unit. Converters (right) for 6 or 2. Use tubes. 6ES8-6U8A-6J6. Output 7-11 mc or 14-18 mc. CN . . $44.95. CN Kit . . $31.95. PS-1 . . $11.50. PS-1 Kit . $10.50. CB6 . . $27.50. CB6 Kit . . $19.95. CB2 . . $33.95. CB2 Kit . . $23.95.



90 Watt transmitter (left, model TX-86), CW AM-peak. 6146 final. Pi net output 35-600 ohms. 5" x 7" x 7", 80-6 meters. Xtal controlled. Requires separate power supply (PS-3). 15 watt CW transmitter (right, model AC-1) 80-40 meters, crystal controlled. TX86 . . $109.95. TX86 Kit . . $84.95. PS-3 . . $44.95. AC-1 Kit . . $17.65.



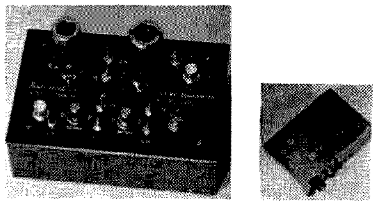
Model CLB (left) 6 meter mobile converter, 12 volts dc power. Model CMA (right), all band converter, 1700 kc-54 mc and 108-174 mc. 3¾" x 6" x 6¾". Requires crystal ($3.50). Uses internal battery. Transistorized. PS-2 power supply provides 12 vdc for CLB from 115 vac. CLB . . $24.95. CMA . . $64.50. PS-2 . . $8.50.



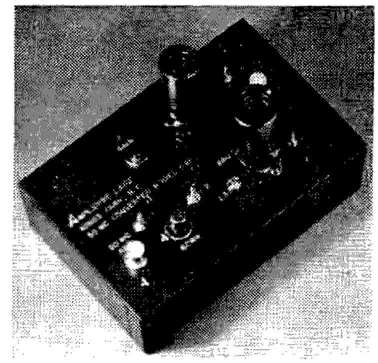
Model CHT, transistorized, built in battery or car battery through BS-9 adapter. CHT converts 2 meters to broadcast band. Can cover from 108-174 mc. Model CLT same as CHT except converts any ham band from 2-54 mc down to the broadcast band or any other i-f output. Model SNL squelch & noice limiter, 6 or 12 vdc. SNLT all transistor. CLT or CHT . . $35.95. BS-9 . . $2.95. SNL . . $17.75. SNLT . . $19.95.

Amplidyne Labs

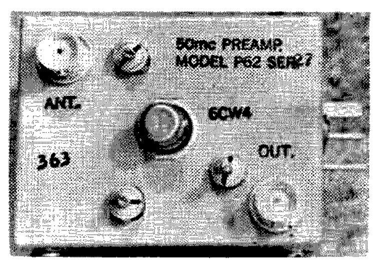
Amplidyne Laboratories
Box 673
Kings Park, L. I., N. Y.



C-23 two meter nuvistor converter. Two 6CW4's in grounded grid rf amplifier, 6J6 crystal oscillator, 6BQ7 mixer-*if* amplifier. Requires separate power supply or voltage from receiver. Output 14-18 mc. Special outputs $1 extra. BNC connectors. 4" x 6" x 2". $34.25. PS-4 Matching power supply $9.75 (right). C-14 1¼ meter nuvistor converter. Identical to the C-23 except input 220-225 mc and price $42.50.

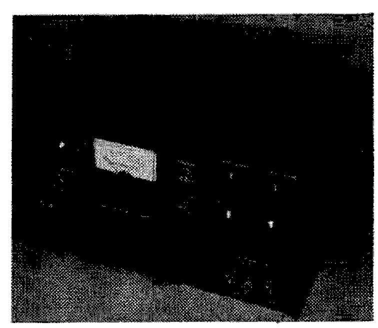


C-61 six meter nuvistor converter. One 6CW4 grounded grid rf amplifier, 6BQ7 mixer and oscillator, 6C4 *if* amplifier. PS-4 matching supply. 14-18 mc output. BNC connectors. 4 x 6 x 2. $28.50.



P-62 Nuvistor preamplifier, 50-54 mc BNC connectors, separate power supply required. $9.75.

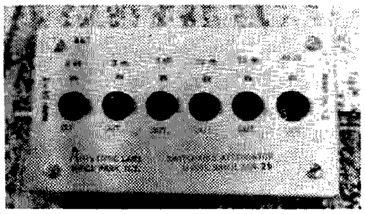
P-25 nuvistor preamplifier, 144-148 mc, BNC's, separate power required. $9.75.



Model 621 six and two meter transmitter. 60 watts to GE 8150, 6L6's plate mod. Xtals or external VFO. Built in dummy load, separate loading controls, spotting button, metering of all stages including rf output using external meter (not supplied). $229.50.

126 nuvistor three band converter, 6-2-1¼ meters, built in power sup-

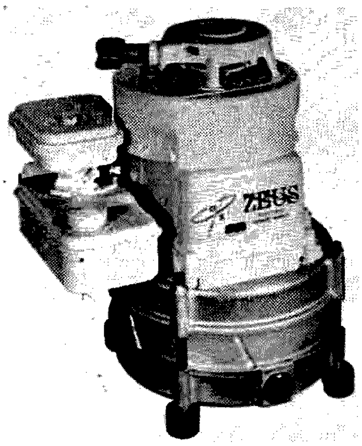
ply, 2-6CW4's, 6DJ8, 6J6. BNC connectors, four *if* outputs (7, 14, 26, 30.5 mc) available. $94.50.
Model 221 (right) is an adapter for the 621 transmitter and puts 18 watts on 220 mc. 6360 output. Uses 55 mc output, power supply, modulator and metering of 621. $72.50.



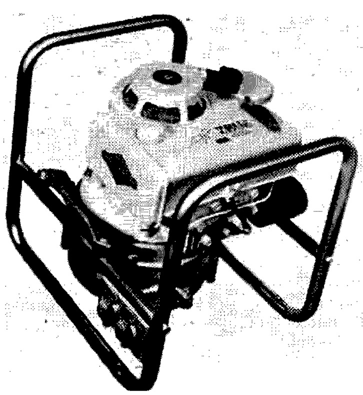
Model SA-601 switchable attenuator. Used for signal-to-noise, noise figure, gain measurements, etc. dc-500 mc. Up to 60 db attenuation. ½ watt. 2¼ x 5 x 3. $14.95.

Antenna Specialists

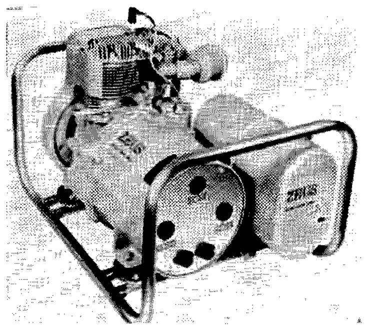
Antenna Specialists
12435 Euclid Avenue
Cleveland 6, Ohio



The Antenna Specialists Zeus ASP-1000 power supply produces 1000 watts of 115 volt 60 cycle ac. The generator is driven by a self-contained gasoline engine and can be handled by one man. $197.50.



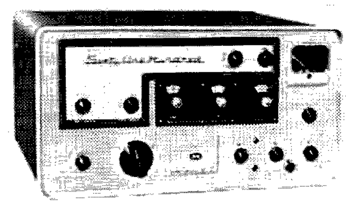
The Zeus ASP-1250-4 power supply delivers 1250 watts at 115 volts ac. This small generator is provided with handles for easy handling. $254.50.



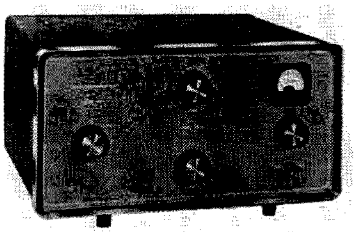
The Zeus ASP-3000 electric power supply delivers 3000 watts of 60 cycle ac at either 115 or 230 volts. The self-contained gasoline engine consumes minute quantities of gasoline and runs quietly. The supply is completely fused and shock mounted. It is light enough to be moved by one man or carried easily by two. Rope starter model $575; electric starting model is $650.

B & W

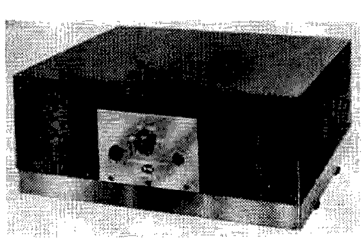
Barker & Williamson, Inc.
Bristol, Pennsylvania



Model 6100 transmitter. Uses crystal frequency synthesizer permitting exact frequency to be set on dials. Covers 10-80 meters, AM-CW-SSB. 2-6146's final, 180 watts CW or SSB, 90 watts AM. VOX, PTT, break-in CW. Built in solid state power supply. Crystal lattice filter. ALC for 10 db voice compression. $875.



Model LPA-1 1 KW grounded grid linear amplifier. 10-80 meters. For use with 100 watt output exciters (such as 6100). 2-813's. 1000 watts input on CW and SSB, 375 watts on AM. Requires separate power supply (LPS-1). Contains filament and bias supplies. $375.



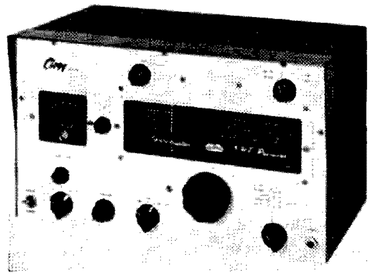
Model LPC-1 power supply. Matching unit for LPA-1 linear. 2500 vdc at 400 ma. Used four 816's. 50 lbs, 8"H, 17"W, 14"D. Has removable control panel which can be mounted at operating position. Remote control cable provided. $205.

B F

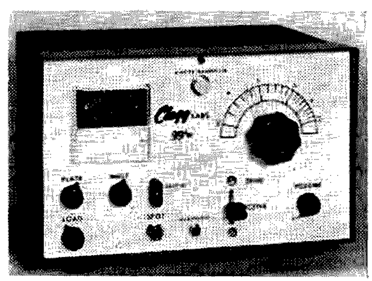
B F Electronics
Box 602
Cardiff, California
The PC-1 and PC-2 mobile power supplies operate from 12 vdc with toroidal circuits. PC-1 has 500 and 250 vdc output at 150 watts. Price: kit $29.95, wired $41.50. PC-2 has outputs of 600 and 300 vdc at 150 watts. Price: kit $34.95, wired $47.50.

Clegg

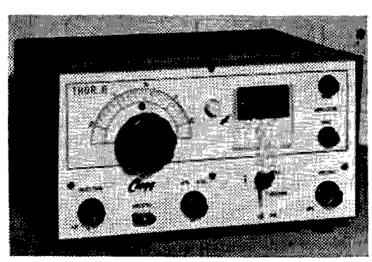
Clegg Laboratories
Rt. 53, Mt. Tabor, New Jersey



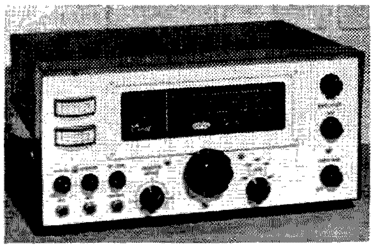
Clegg Interceptor six and two meter receiver. Tunes 50-54 mc with built in converter for 144-148 mc. Flywheel dial, entire dial tunes one mc at a time. Nuvistor rf stages. Crystal lattice filter for selectivity. Designed for low cross-talk. Will tune any other bands, higher or lower, with converter. 15" w, 9" h, 9" d. 32 lbs. $473.



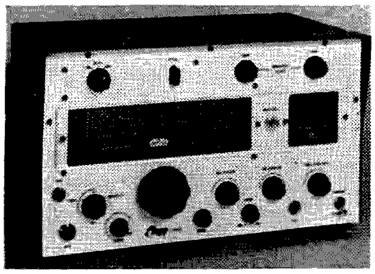
Clegg 99'er six meter transceiver. Double conversion receiver, S-meter, spotting switch. Transmitter crystal controlled (or external VFO), 8 watts to 7558 final, plate modulated. Receiver covers 50-52 mc for good bandspread. AC power supply built in. S-meter switches for transmitter tuning. 10" w, 6" h, 8" d. 14 lbs. $199.99.



Clegg Thor, six meter transceiver. Receiver has crystal lattice filter for selectivity, BFO, tunes 50-52 mc, external speaker (not supplied). Designed for low cross modulation, images, *if* leakthrough. Transmitter is VFO in receiver frequency or crystal controlled. 60 watts on AM or CW to a 6883 final. Separate (but included) power supply and modulator uses two 6CU6's in Class B. S-meter switches for transmitter tuning automatically. Variable BFO injection for SSB detection and spotting. ANL. 12" w, 6" h, 8½" d. 15 lbs. Power unit 12" w, 6½" h, 8½" d. 27 lbs. $349.95. 12 vdc transistorized supply $119.95.



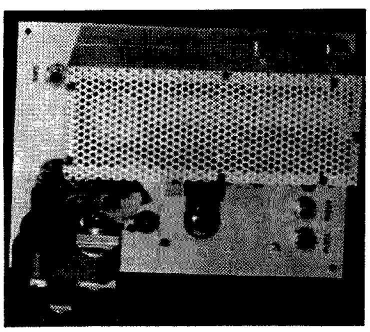
Clegg Venus VI, SSB transceiver for six meters. Receiver tunes 50-50.5 mc (or any other 500 kc band if specified), crystal lattice filter for selectivity, nuvistor front end. Transmitter 85 watts AM, SSB, CW to 6883 final. Tuning dial: 1 kc per division. Receiver may be offset from transmitter frequency by plus or minus 1 kc. Requires separate power supply. $475. AC power supply $115, 12 vdc supply $120.



Clegg Zeus six and two meter transmitter. 185 watts AM or CW on both bands to a 7034. 811A's class B plate modulation, 18 db speech clipping with automatic modulation control. Crystal oscillator or built in ultra-stable VFO. Flywheel tuning dial. Power supply and modulator in separate unit with interconnecting cable. $695.

Centimeg

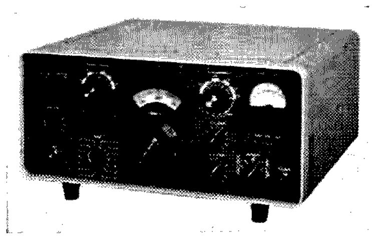
Centimeg Electronics
312 East Imperial Highway
El Segundo, California



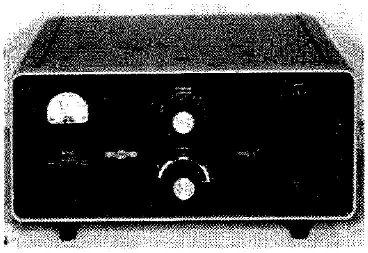
Model TA-4.3 is a 432 mc tripler. Driven by 5 watts at 144 mc final 2C39 50 watts input on 432 mc. Tank circuit is silver plated cavity. Blower. Separate power supply and modulator required. 8" x 5" x 5" h. $69.50 without 2C39, $84.50 with.

Collins

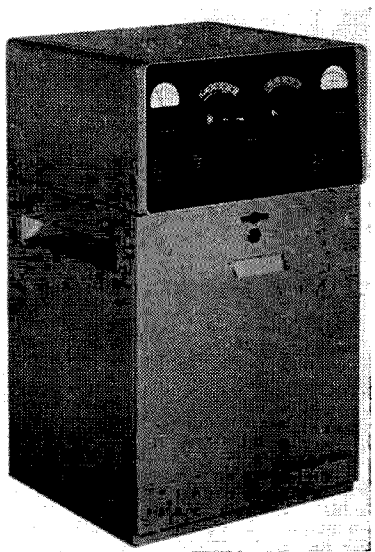
Collins Radio Company
Cedar Rapids, Iowa



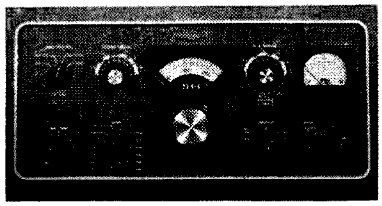
The KWM-2 transceiver, 175 watts of PEP SSB or 160 watts CW on 14 200 kc bands between 3.4 and 29.7 mc. Features include filter type SSB, VOX, anti-trip, ALC, break-in CW and sidetone CW monitor. Power requirements may be obtained from the matching 516E-1 dc power supply or 516F-2 ac supply. Size: 7¾" h, 14¾" l, and 13¼" d. Weight: 18 lbs. Price: $1150.



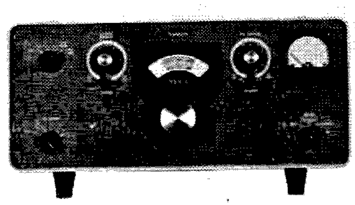
The 30L-1 is a table top linear amplifier for use with 100 watt transmitters. 4-811A's operate at 1 kw PEP from 80-10 meters. The self contained power supply uses silicon diodes. Size: 6½ h, 14¾ w, 13¾ d. Weight: 38 lbs. Price: $520.



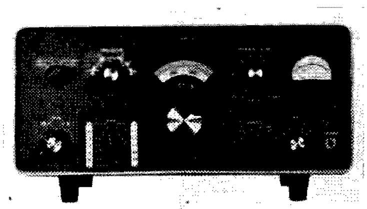
The 30S-1 is a grounded grid linear amplifier with 1 kw input to a 4CX1000A on all bands 80-10. Requires 100 watts drive. Self contained power supply, blower and ALC. Size: 30⅝ h, 17 w, 16⅝ d. Weight: 160 lbs. Price: $1556.



The 32S-3 transmitter, 175 watts PEP SSB or 160 watts CW on any 13 200 kc segments from 3.4 to 30 mc. 10 db of rf feedback, ALC, mechanical filter SSB, and carrier insertion keying. Size: 6⅞ h, 14½ w, 11⅝ d. Weight: 17 lbs. Price: $750 less power supply.



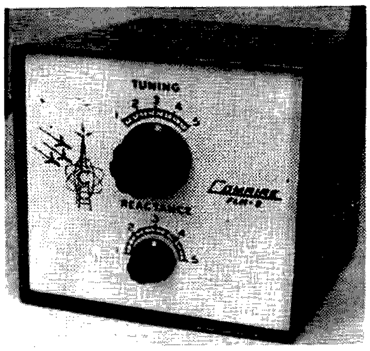
The 62S-1 converts a 14 mc AM, CW, SSB, or RTTY signal to 6 or 2 meters. Receiver sensitivity is 1.3 uv and power input 165 watts PEP. High voltage is taken from the present exciter. Size: 7¾ h, 14¾ w, 13¼ d. Weight: 26 lbs. Price: $1556.



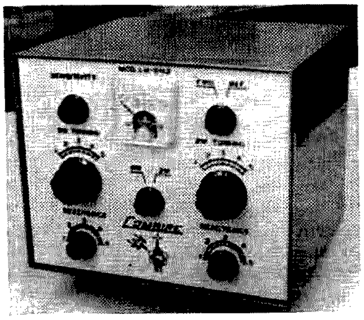
The 75S-3 receiver covers the 80-15 meter bands and 3-200 kc segments of the 10 meter band. The circuit uses 11 tubes, a 2.1 kc mechanical filter for SSB, and a 200 cycle crystal filter for CW. Size: 7¾" h, 14¾" w, 11½" d. Weight: 20 lbs. Price: $680.

Comaire

Comaire Electronics
Box 126
Ellsworth, Michigan



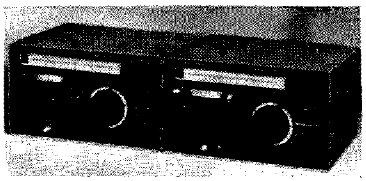
FLM-2 two meter line matching unit to match transmitter to feedline. FLM-6, same thing only for six meters. $19.95.



LM-6N2 Line matcher. Combination six and two meter antenna tuner with built in SWR power meter. 500 watts. 7½" x 6" x 7". 8 lbs. Tuners are completely separate. $59.75.

Dovco

Davco Electronics Company
113 Norwood Avenue
Asheville, North Carolina



The DT-20a transmitter (left) operates on 80-10 meters with 20 watts SSB output, 8 watts AM. Transistorized, tube final, mechanical filter SSB generator, VFO, VOX, separate power supply, transceiver operation with DT-30. Size: 4 h, 7½ w, 5 d. Price: $345.00.

The DR-30 receiver (right) tunes all bands 80-10 plus WWV, broadcast and 3 other 500 kc bands. Completely transistorized, 2.1 kc mechanical filter, crystal calibrator, S-meter, ANL, crystal and variable BFO, double conversion, injection voltages for transceiver operation with DT20 exciter. Size: 4 h, 7½ w, 5 d. Price: $289.50. DQ-1 Q-multiplier, ac supply, speaker and battery holder $36.00.

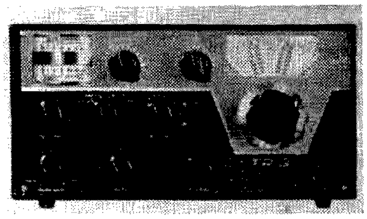
Dow Key

Dow Key Company
Thief River Falls, Minnesota

Model DKC-RFB 50-70 ohm impedance matching broadband preamplifier. 1.5-30 mc. Power can be taken from receiver. SO-239 connectors. 6CB6 tube. 1¾" x 2", 6 oz. $10.75.

Drake

R. L. Drake Company
Box 185
Miamisburg, Ohio 45342

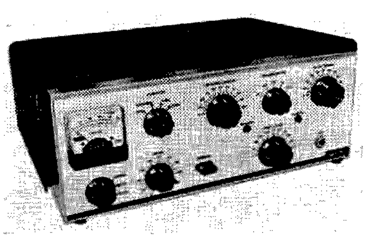


The TR-3 transceiver covers 80-10 meters with 300 watts PEP SSB input or 260 watts shifted carrier CW input. 2.1 kc selectivity, .5 uv sensitivity, rf and af gain controls, product detector, crystal filter sideband, crystal calibrator, 3-12BJ6's in final, VOX, PTT, S-meter. Size: 5½ h, 10¾ w, 14⅜ d. Weight: 13½ lbs. Price: $550, AC-3 ac supply $79.95, DC-3 dc supply $129.95, RV-3 remote VFO $79.95, MS-3 speaker $19.95, MMB-3 mobile mount $3.95.

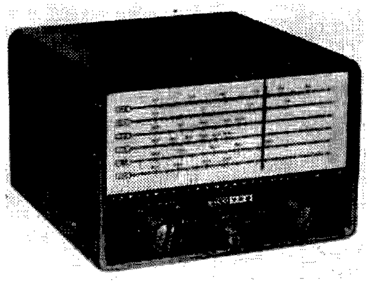
The 2-B receiver covers 80-10 meters and other bands with extra crystals. .5 uv sensitivity, .5-3.6 kc selectivity, slow or fast AVC, product or diode detector, triple conversion, noise limiter, preselector, less speaker, calibrator, Q-multiplier. Size:
Weight: Price: $279.95. 2-BQ Q-multiplier and speaker $39.95, 2-BS speaker $16.95, 2-AC calibrator $16.95.

EICO

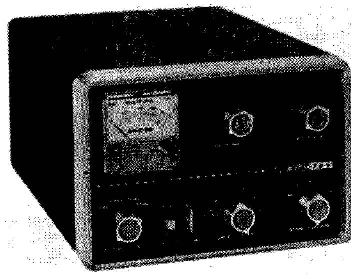
Eico Electronic Instrument Co., Inc.
3300 Northern Blvd.
Long Island City 1, N. Y.



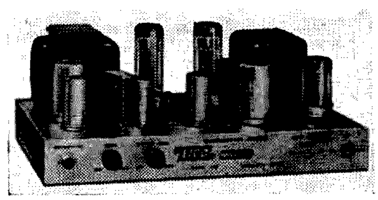
The #720 CW transmitter is a 90 watt rig for 80-10 meters. The 6146 final amplifier can be externally plate modulated for 65 watts of AM. Crystal control or external VFO such as the Eico 722. TVI suppressed, final protection by 6AQ5 clamper. Size: 15 w, 5 h, 9 d. Weight: 30 lbs. Price: Kit, $89.95; Wired, $129.95.



The #722 VFO provides a signal to drive any low power transmitter on 80 thru 10 meters. It has a self contained power supply and regulator. Size: 6 h, 8½ w, 9 d. Price: Kit, $44.95; Wired, $59.95.



The #723 CW transmitter is a 60 watt Novice or standby rig using crystal control or external VFO. An external modulator such as the Eico #730 can be used to plate modulate the 6DQ6B final. Single knob band and operate switches are incorporated. Size: 6 h, 8½ w, 11¼ d. Weight: 15 lbs. Price: Kit, $59.95; Wired, $89.95.



The #730 modulator delivers 50 watts of audio to plate modulate any 100 watt transmitter or drive a high power modulator. A multi-match transformer enables it to be used with any transmitter. Input can be from high or low impedance mike or phone patch. Size: 6 h, 14 w, 8 d. Weight: 21 lbs. Price: Kit, $59.95; Wired, $89.95.

Electrocom

Electrocom Industries
1105 N. Ironwood Drive
South Bend, Indiana
The FSC-250 frequency shift converter includes autostart, 3 power supplies, 2" monitor scope, and single channel or polar operation. Size: 3½ h, 19 w, 11 d. Price: $325.00.

Electronics Specialists

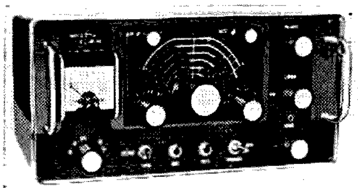
Electronic Specialists Laboratories
301 South Ayer Street
Harvard, Illinois

The ESL nuvistor pre-amp is available in models for 27-30, 50-54, 144-160, and 220-225 mc. Size: 2 w, 1⅝ h, 1⅝ d. Price: wired $8.95,

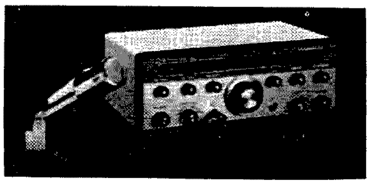
kit $5.95. All nuvistor converters $56.95 with power supply, $44.95 without.

Elmoc

Multi-Elmac Company
21470 Coolidge Highway
Oak Park 37, Michigan



The AF-68 transmitter delivers 60 watts on 80-6 meters with a 6146 final. VFO, plate modulation, pi-net output, less power supply. Size: 6½ h, 13½ w, 7½ d. Weight: 18 lbs. Price: $205.00. M-1070 power supply $79.50 wired, $59.50 kit.

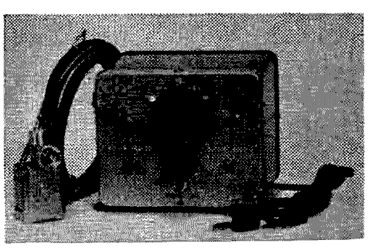


The ATR-4 transceiver covers 80-10 meters with 180 watts PEP SSB, 75 watts AM and 180 watts CW input. S-meter, 2.7 kc selectivity, product detector, 100 kc calibrator, parallel 6146's, VOX, anti-VOX, break-in CW, adjustable sidetone, push to talk. Size: 5½ h, 15¾ w, 9⅝ d. Weight: 19 lbs. Price: $750.00.

The PMR-8 receiver tunes 80-6 meter bands (50-52 mc on 6) and the broadcast band. 262 kc *if*, tunable BFO, noise limiter, AVC, antenna trimmer, less power supply. Size: 4 h, 7 w, 9 d. Weight: 11 lbs. Price: $189.50.

Fichter

Fichter Electronics
33 Myrtle Avenue
Cedar Grove, New Jersey

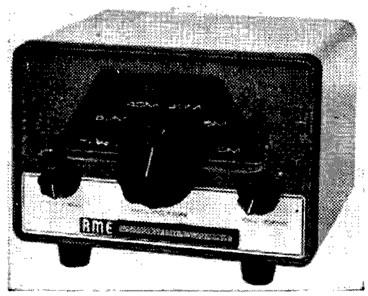


Model 102A Transtenna. Combination send-receive "switch," preselector, CW monitor. Power supply built in. Eliminates need for antenna relay, mutes receiver on transmit, provides sidetone by means of a transistor oscillator for CW monitoring: $76.45. Without sidetone $69.45.

G.C.

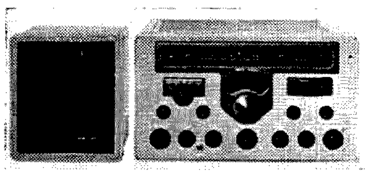
G. C. Electronics Co.
400 S. Wyman St.
Rockford, Illinois

The 65-421 screen modulator kit can be used with most any CW transmitter. Self contained. Price: $11.95.

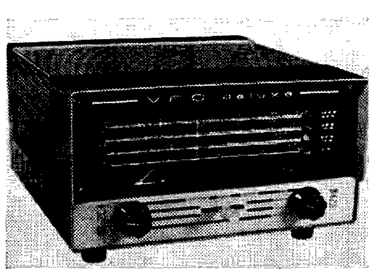


The DB23 preselector provides 26 to 36 db gain on 80-10 meters, depending on band and antenna matching. 3-6J6's, selenium power supply. Size: 5 h, 7⅝ w, 6 d. Weight: 6 lbs. Price: $49.50.

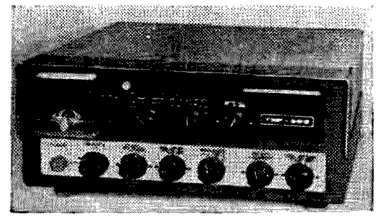
The HG-303 transmitter has 75 watts input to a 6146 on 80-10 meters. Silicon powered, crystal controlled, external VFO, grid block keying, pi net. Size: 4½ h, 9 w, 8 d. Weight: 22 lbs. Price: $109.95.



The RME-6900 is a ham-band receiver covering 80-10 meters and WWV on all modes. Noise limiter, BFO injection control, selectable sideband, crystal calibrator, silicon power supply. Size: 10 h, 16½ w, 10 d. Weight: 36 lbs. Price: $369.00, 6901 matching speaker $19.50.



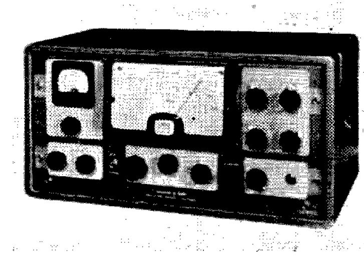
The V-10 VFO covers 160-6 meters with output for any transmitter. Voltage regulator, calibrate switch, cathode follower. Size: 4⅝ h, 9⅛ w, 9⅝ d. Weight: 9 lbs. Price: $69.95. The VHF-126 converts 6, 2 and 1¼ meter signals to 7 mc. The tunable converter has dual speed tuning and double conversion on 144 and 220 mc. Size: 10 h, 16½ w, 10 d. Weight: 35 lbs. Price: $239.00.



The VHF-602 transmitter covers 50-54 and 144-148 mc with 60 watts CW and 50 watts AM input. Speech clipper, 10 tubes, 6146 final, TVI shielded, plate modulation. Size: 4¾ h, 12 w, 12⅜ d. Price: $179.95.

Geloso

American Geloso Electronics, Inc.
251 Park Avenue South
New York 10, New York



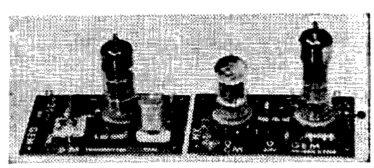
The G-209 amateur receiver covers 80-10 with 12 American tubes plus power supply. Double conversion, 5 position selectivity, crystal calibrator, noise clipper, S-meter. Size: 20½ w, 10½ h, 10¼ d. Weight: 52 lbs. Price: $249.50.

The G-222/TR transmitter covers 80-10 meters with VFO and plate modulation. Matches G-209, 75 watts to 6146, pi-net, power supply, cathode keying. Size: 20½ w, 10½ h, 10¼ d. Weight: 63 lbs. Price: $259.50.

The Geloso VFO's are available in 3 tuning ranges, all less power supply and tubes. 4/102 tunes 80-10 meters in 5 ranges, will drive 2-6146's. Price: $29.95. 4/103 has 144-148 mc output, drives 832 or 2E26. Price: $29.95.

Gem

Gem Electronics
P.O. Box 203
Tremont City, Ohio



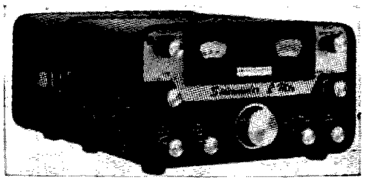
(Left) 5 watt transmitter and exciter unit. Uses 7-8 mc xtals, 6AU8 or 6CX8 tube, freq range available 7-60 mc, 2½" x 4" p.c. Less tube $6.50, with tube $7.50.

(Right) 5 watt audio and modulator unit. 12AX7 & 6AQ5, input for xtal or carbon mike, 2½" x 4" p.c. $4.50. Tubes $2.00. Case $2.50. Also available are a nuvistor six meter converter, 2-6DS4's, 2-6CW4's, *if* BC to 18 mc $6.50 less tubes and xtal. Two meter model with either 10 mc or 50 mc *if* is $7.50. Case for converters with power connectors, etc., $6.50.

6 and 2 meter nuvistor cascode preamplifiers 2½" x 2" p.c. $4.00. Deluxe mount $6.50.

Gonset

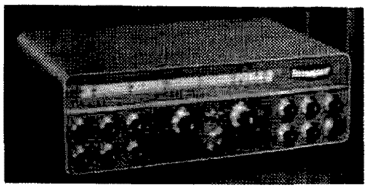
Gonset Inc.
801 South Main Street
Burbank, California



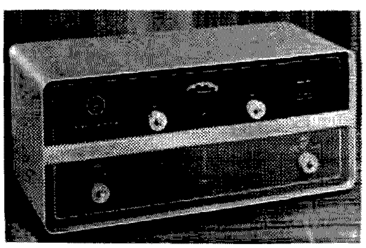
Gonset Sidewinder. Two meter transceiver, SSB, AM, CW, mobile or fixed, PTT, two speed tuning dial, tunes 1 mc, bandswitches for each of the four mc, receiver transistorized for compactness and low drain, transmitter transistorized except mixer, driver and final. Crystal lattice filter. S-meter. 20 watts PEP to 6360 final, 6 watts AM. Transistorized power supply fastens to rear of transceiver. Draws .05 amps at 12.6 vdc in receive position, 1 amp for transmitter standby, 8 amps during transmit. Power supply operates from 12 vdc or 117 vac. 8¾" w, 4¾" h, transceiver 7" d, power supply 5½" d. Weight 19 lbs. Sidewinder: $349.95. Power supply kit $39.95, wired $49.95.

Hallicrafters

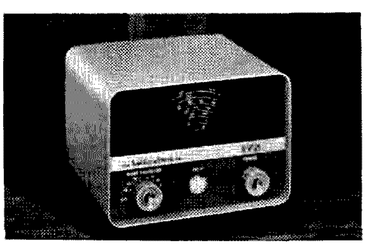
Hallicrafters
Chicago 24, Illinois



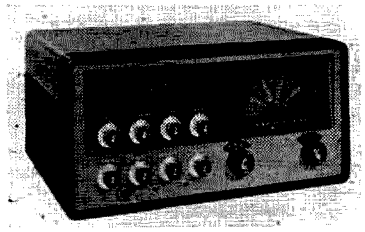
FPM-200 transistorized transceiver, 80-10 meters, sideband-CW-AM, 150 watts input on SSB PEP, VOX, dc power supply built in, two separate PTO's for bilateral operation. Tubes used only in driver and final (6146's). 16"W, 5"H, 11"D, 24½ lbs. $26.50.



HA-2 and HA-6 transverters. Converts ten meter transmitters and receivers to six or two meters. 5894 final for 120 watts input, can be driven by any 10M exciter from 10-100 watts. Requires separate (P-26) power supply. 8"H, 17"W, 9"D.

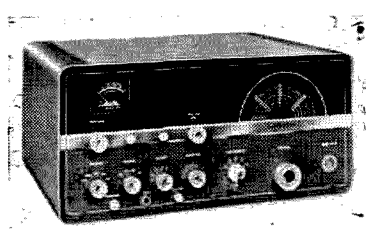


HA-5 VFO. Self powered heterodyne type VFO, 80-40-20 meter output plus 8 mc output for six and two meter transmitters. 7"W, 5"H, 8½"D. $79.95.
HA-8 modulation indicator. Built in power supply, indicates 100% modulation, complete with rf probe and connecting cable. 7½"W, 2½"H, 5¾"D. $24.95.

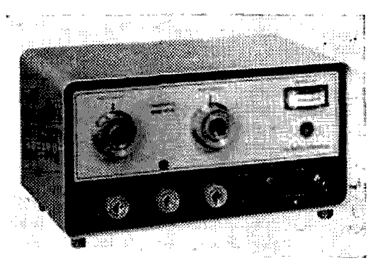


HT-32B transmitter. 80-10 meters, 144 watts PEP SSB to 6146's, dial reads in kc, power supply built in, double sideband AM, VOX, PTT, 20"W, 10½"H, 17"D, $725.

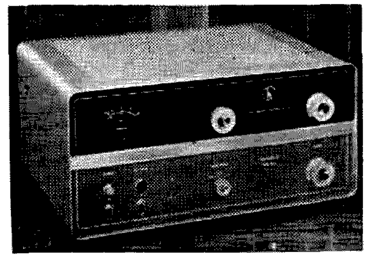
HT-33B Linear amplifier. 80-10 meters, PL-172 final will run full legal maximum input, designed to be driven by HT-32B, 20"W, 10½"H, 17"D. Power supply built in. Two panel meters. $995.



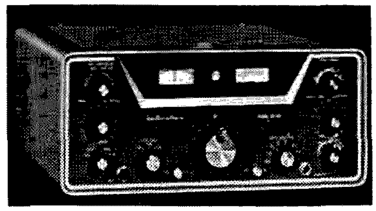
HT-37 transmitter, 144 watts PEP, 80-10 meters, CW, SSB, AM (both sidebands), VOX, 6146's final, power supply built in. 19¼"W, 9"H, 15½"D. $495.



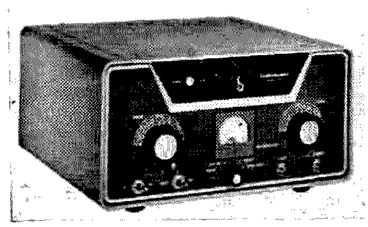
HT-40 transmitter. 75 watts AM/CW to 6DQ5, 80-6 meters, tuning meter, crystal controlled, built in modulator and power supply, 13½" x 8" x 6½". $89.95 in kit form (HT-40KO, $109.95 wired).



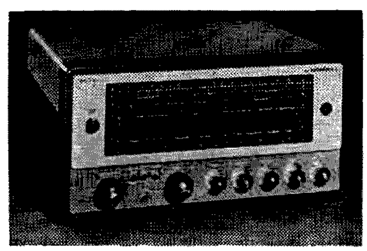
HT-41 linear amplifier. Companion unit to HT-37, 80-10 meters, two 7094's, built in power supply, 19¼" x 9" x 15½", 1000 watts PEP, 800 watts CW, 400 watts AM phone. RF output meter. $395.
HA-10 tuner. Low frequency tuner for use with SX-117, tunes 85 kc to 3 mc. $24.95, less crystals.
HA-4 "T.O." keyer. Transistorized digital type keyer.



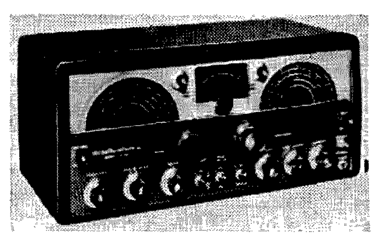
HT-44 transmitter. Designed to operate with SX-117 as transceiver or separately with own VFO, 200 watts SB/CW, 80-10 meters, AM/CW/SB, break-in CW, VOX, PTT, requires separate power supply (PS-150), 15" x 7" x 13".



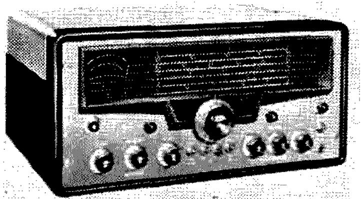
HT-45 amplifier. 3-400Z grounded grid for 1000 watts CW, 2000 watts PEP SSB, 80-10 meters, requires separate power supply (P-45), 15" x 7" x 13".



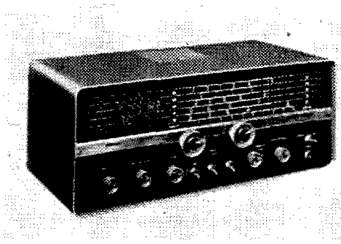
SX-62A receiver. 550 kc-109 mc, AM/FM/CW, crystal calibrator, two rf stages, six position selectivity, 20"W, 16"H, 10½"D. Uses separate speaker. $430.



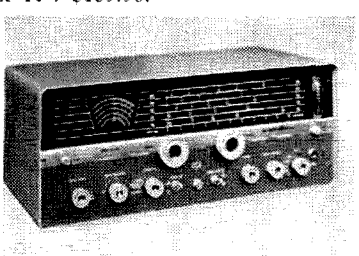
SX-100 receiver. General coverage 540 kc-34 mc, bandspread dial for 80-10 meter bands, T-notch filter, crystal calibrator, selectable sideband, S-meter, 18½" x 8½" x 10½". $325.



SX-101A receiver. Covers 80-10 meters plus dial scale for 6 & 2 meters for use with converters. S-meter, sideband selection, T-notch, five steps of selectivity. $445.



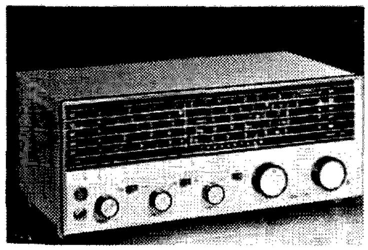
S-108 receiver. All band, 540 kc to 34 mc, calibrated bandspread on 80-10 meter amateur bands, BFO, ANL, built in speaker, 18½" x 8½" x 11". $139.95.



SX-110 receiver. Same as S-108 but includes S-meter, antenna trimmer, and crystal filter and uses separate speaker. $169.95.

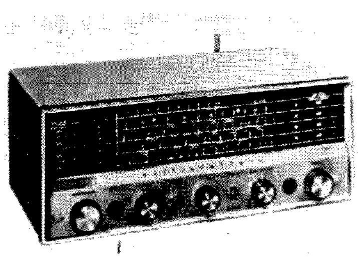
SX-115 receiver, tunes 9 500 kc segments, 80-10 meters plus WWV, 1 kc calibration, 5-step selectivity, separate noise limiters for SSB/AM/CW, 100 kc calibrator, product detector for SSB and CW, S-meter, BFO, Q-multiplier, 16"W, 10½"H, 16"D. $599.50. R47 Speaker $12.95. R48 Speaker $19.95.

SX-117 triple conversion receiver. Product detector for SSB/CW, *if* noise limiter, T-notch filter, S-meter, selectivity .5, 2.5, 5 kc, 80-10 meters, BFO, ANL, crystal calibrator, 15" x 7" x 13". $379.95.

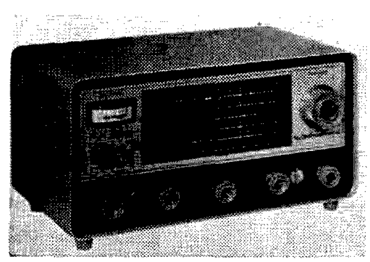


S-118 receiver. 185-420 kc, 495 kc-31 mc in five bands, BFO, loopstick antenna for low bands, built in speaker, $99.95.

S-119 receiver. Sky Buddy II. 2-5.5 mc, 6-16.5 mc, 535-1620 kc. Built in speaker, superhet, 3 tubes plus diode. $29.95 in kit form, $49.95 wired.



S-120 receiver. 550 kc-30 mc in four bands, electrical bandspread, BFO, loopstick antenna for lower bands, adjustable whip for SW, built in speaker, $69.95.

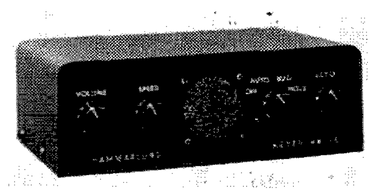


SX-140 receiver. 80-6 meters, S-meter, crystal calibrator, BFO, ANL, 13½"W, 6½"H, 8"D. $139.95 wired, $114.95 in kit form.

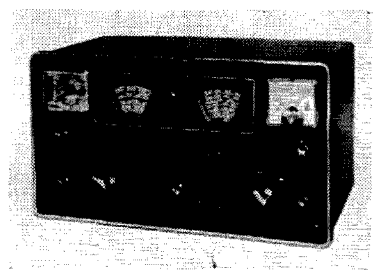
SR-150 transceiver, 80-10 meters, SSB-CW, 150 watts PEP SSB, 125 watts CW, 100 kc calibrator, receiver may be offset from transmit frequency by 2 kc, VOX, 6½" x 15" x 13", 17½ lbs. Requires separate power supply. $650. P150 ac $99.50. P150 dc $109.50. MR150 mounting rack $39.95.

Hammarlund

Hammarlund Manufacturing Company, Inc.
460 West 34th Street
New York 1, N. Y.

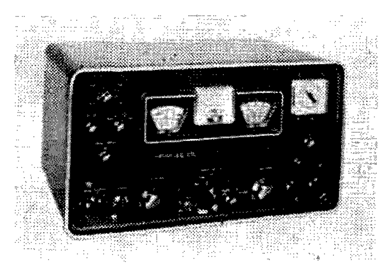


The HK-1B is a transistorized, battery-operated electronic keyer. Keying relay, self contained battery, monitor and speaker. Ratio, volume and speed controls. Size: 2⅜ h, 7 w, 4½ d. Weight: 2½ lbs. without battery. Price: $39.95 less battery.



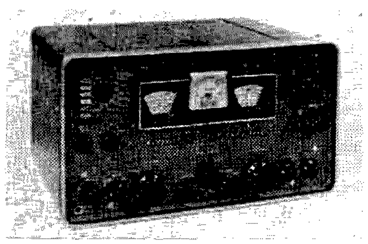
The HQ-100A is a general coverage .54-30 mc receiver with calibrated amateur bandspread. Logging scale, ANL, Q-multiplier, variable selectivity, less speaker and clock. Size: 9½ h, 16¼ w, 9⅛ d. Weight: 32 lbs. Price: $189.00

The HQ-110A is an amateur band receiver for 160-6 meters with dual conversion above 7 mc. Q-multiplier, crystal calibrator, product detector, ANL, S-meter, 1.5 uv sensitivity, less clock and speaker. Size: 9½ h, 16¼ w, 9⅛ d. Weight: 32 lbs. Price: $249.00; matching speaker $14.95.

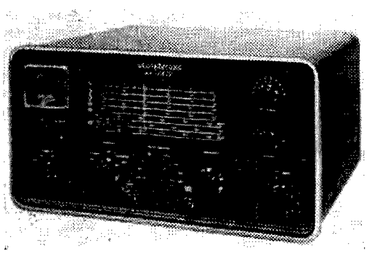


The HQ-145X is a general coverage receiver .54-30 mc with calibrated amateur bandspread. Dual conversion above 10 mc, crystal filter, slot filter, ANL. Less speaker, clock, and crystal calibrator. Size: 10½ h, 19 w, 13 d. Weight: 44 lbs. Price: $279.00, crystal calibrator $15.95.

The HQ-170A receiver covers the 160-6 meter bands with triple conversion above 7 mc and dual below. Selectable sidebands, product detector, selectable AVC, slot filter, ANL-squelch, vernier tuning, .5-6 kc selectivity, S-meter, less speaker and clock-timer. Size: 10½ h, 19 w, 13 d. Weight: 38 lbs. Price: $369.00; clock $10.00; matching speaker $19.95; noise silencer accessory $33.50.

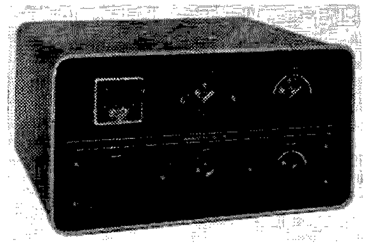


The HQ-180A is a general coverage .54-30 mc receiver with calibrated amateur bandspread. Triple conversion above 7.85 mc, dual below. S-meter, crystal filter, slot filter, product detector, selectable AVC, crystal calibrator, ANL, .5-6 kc selectivity, less speaker and clock. Size: 10½ h, 19 w, 13 d. Weight: 38 lbs. Price: $439.00

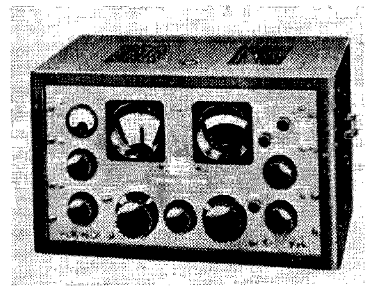


The HX-50 is an AM-CW-SSB transmitter for 10-80 meters. 130 watts PEP SSB, 130 watts CW, 90 watts AM. VFO, filter type sideband, pi network, VOX, anti-trip, antenna relay. Size: 9½ h, 17 w, 9 d. Weight: 45 lbs. Price: $449.50.

The HX-500 is an 80-10 meter transmitter for 100 watts of CW, PEP SSB, FM, or FSK and 25 watts of AM. Calibration to 200 cycles, VOX, anti-trip, ALC, built in power supply. Size: 11½ h, 19¼ w, 16⅛ d. Weight: 85 lbs. Price: $695.00.



The HXL-1 is a grounded grid linear for 1500 watts PEP SSB, and 1000 watts CW. 50-60 watts drive, 80-10 meters, built in silicon power supply, pi-network, provision for 160 meters. Size: 9⅛ h, 17½ w, 9½ d. Weight: lbs. Price: $375.00.

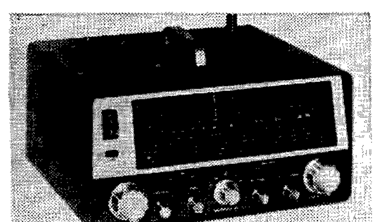


The SP-600-JX is a general coverage receiver for .54-54 mc. Dual conversion over 7.4 mc, crystal filter, .2-13 kc selectivity, 2.3 uv sensitivity, S-meter, phono input, less speaker. Size: 12¾ h, 21⅜ w, 17⅛ d. Weight: 88 lbs. Price: $1140.00.

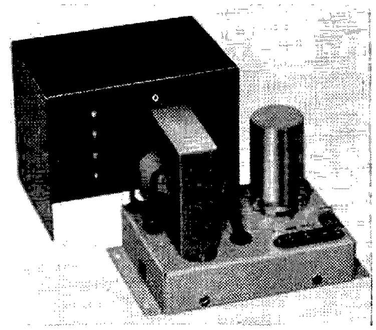
Heath

Heath Company
Benton Harbor, Michigan

The DX-60 is a 90 watt AM or CW transmitter kit for 80-10 meters. 6146 final, low pass filter, carrier control modulator. Size: 6½ h, 13¾ w, 11½ d. Weight: 25 lbs. Price: $79.95.

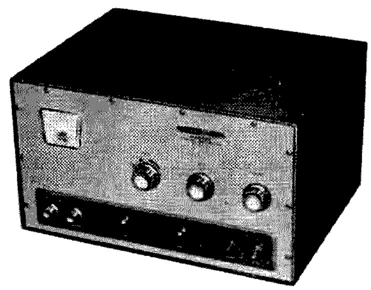


The GC-1A Mohican is a transistorized, portable general coverage receiver. 10 transistors, 6 diodes, S-meter, ANL, BFO, speaker, calibrated amateur bandspread, less batteries or ac supply. Size: 6⅞ h, 12 w, 10 d. Weight: 18 lbs. Price: $109.95 kit, $193.50 wired. Accessory ac power supply $9.95.

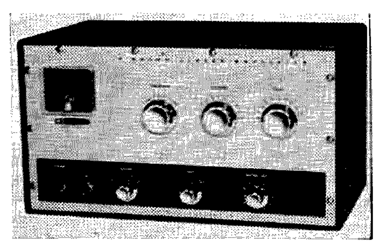


The GP-11 vibrator power supply kit delivers 250 vdc at 100 ma from a 6 or 12 vdc source. Designed to power mobile transceivers. Silicon diodes. Size: 4⅝ h, 6½ w, 4⅛ d. Weight: 6 lbs. Price: $16.88.

The GR-91 is an SWL or Novice general coverage .55-30 mc receiver kit. BFO, noise limiter, electrical bandspread, speaker, antenna trimmer. Size: 5½ h, 12¼ w, 8¼ d. Weight: 15 lbs. Price: $39.95.

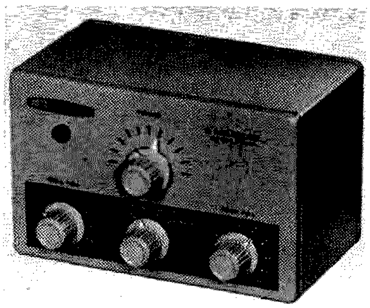


The HA-10 Warrior linear amplifier runs 1000 watts CW, 1000 watts PEP SSB, 400 watts AM, and 650 watts RTTY to 4-811A's with 50-75 watts drive. Self-contained power supply, forced air cooling, grounded grid circuit, TVI shielding. Size: 11⅝ h, 19½ w, 16 d. Weight: 99 lbs. Price: kit $229.95, wired $329.95.

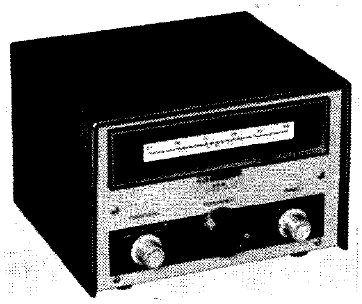


The HA-20 is a 6 meter linear amplifier kit to match the HX-30. 2.5-10 watts drive, 125 watts PEP

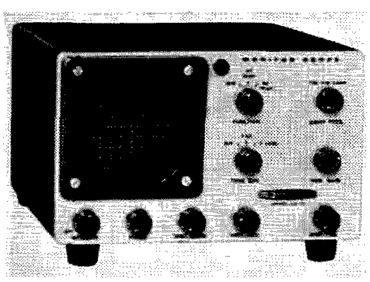
SSB, 75 watts AM, push-pull 6146's, forced air cooling, self-contained power supply. Size: 10⅛ h, 16⅝ w, 10 d. Weight: 43 lbs. Price: $99.95.



The HD-11 is a Q-multiplier kit for use with any receiver having an *if* of 450-460 kc. 2 peaking positions, 1 rejection notch, built-in power supply. Price: $14.95.



The HG-10 is a VFO kit for all bands 80-2 meters. May be used with most transmitters, grid-block or cathode keying. Clapp oscillator, less power supply. Size: 6½ h, 9⅜ w, 9 d. Weight: 12 lbs. Price: $34.95.

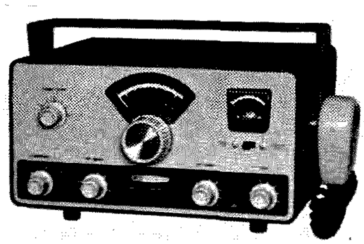


The HO-10 is a monitor scope kit for observation of af and rf trapezoid patterns, AM and SSB envelopes on ham transmitters. Handles 5-1000 watts, 6-160 meters. Two-tone test signal, rf attenuator. Weight: 10 lbs. Price: $59.95.

The HR-10 is a 80-10 meter ham band receiver kit for all modes. S-meter, BFO, ANnl, AVC, less speaker and crystal calibrator. Size: 6½ h, 13¾ w, 11½ d. Weight: 21 lbs. Price: $79.95, crystal calibrator $8.95.

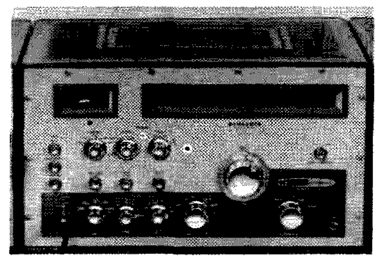
The HR-20 is an 80-10 meter mobile receiver kit. 8 tubes, product detector, noise limiter, slow or fast AVC, S-meter, less speaker and power supply. Size: 6¼ h, 12¼ w, 9¾ d. Weight: 17 lbs. Price: $134.50.
Mobile speaker $5.95, mobile base mount $4.95.

The HW-10 and HW-20 are 6 and 2 meter transceiver kits, respectively. 6 meter Shawnee covers 49.8-54 mc, 2 meter Pawnee 143.3-148.2 mc. Both feature built-in supply for 6, 12 or 120 volts. 10 watt 6360 final, push-to-talk microphone, VFO or crystals, internal speaker, 15 kc selectivity, double conversion, squelch, BFO, AVC. Size: 6 h, 12 w, 10 d. Weight: 34 lbs. Price: $199.95.

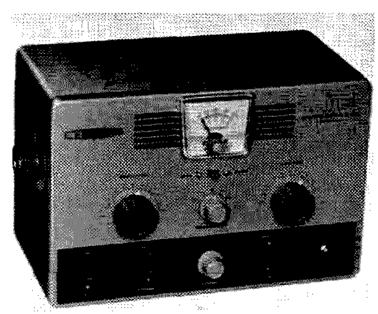


The HW-12, HW-22, and HW-32 are single band SSB transceivers for 80, 40 and 20 meters, respectively. LSB on 40 and 80, USB on 20. 200 watts input to 2-6GE5's, VOX, PTT, 14 tubes, crystal filter SSB, 2.7 kc selectivity, 1 uv sensitivity, S-meter, less microphone, crystal calibrator and power supply. Size: 6¼ h, 12 w, 9¾ d. Weight: 15 lbs. Price: $119.95, GH-12 push-to-talk microphone $6.95, crystal calibrator $8.95, HP-23 ac supply kit $39.95, HP-13 dc supply kit $59.95.

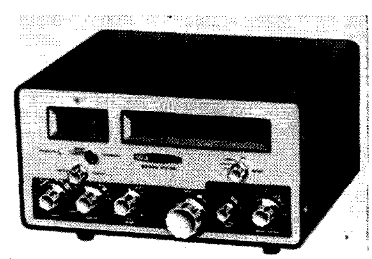
The HW-29A and HW-30, the Sixer and Twoer, are 6 and 2 meter transceiver kits. Crystal controlled transmitters, 5 watts input to a 6CL6, tunable superregenerative receiver, with microphone, less crystal and mobile power supply, built-in ac supply. Weight: 8 lbs. Price: $44.95, GP-11 mobile power supply kit $16.88.



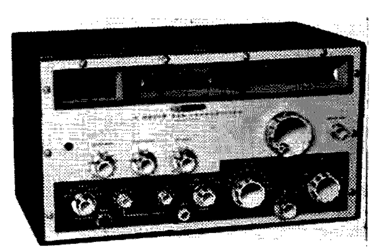
The HX-10 Marauder is a 180 watt CW and PEP SSB, 75 watt AM, transmitter kit for 80-10 meters. Filter SSB, VOX ,anti-trip, break-in CW, ALC, 2-6146's in final, accessory socket, with power supply. Size: 11 5/5 h, 19 w, 16 d. Weight: 92 lbs. Price: $334.95.



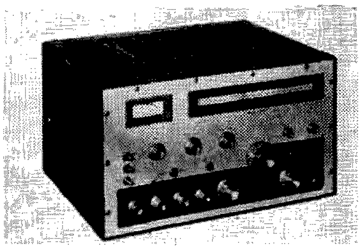
The HX-11 CW transmitter kit runs 50 watts to a 6DQ6A on 80-10 meters. Crystal controlled, may be driven by external VFO. Bandswitching, pi-network output. Size: 8½ h, 13 w, 7 d. Weight: 17 lbs. Price: $43.50.



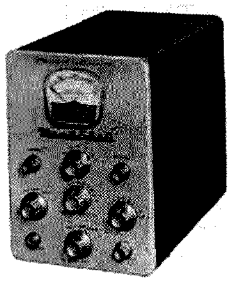
The HX-20 is an SSB and CW mobile transmitter kit with 90 watt input. Matches HR-20 and uses same power supplies. Filter SSB, 6146 final, VOX, anti-trip, VFO, ALC, fixed loading, push to talk, less power supply. Size: 6¼ h, 12¼ w, 9¾ d. Weight: 19 lbs. Price: $199.95.



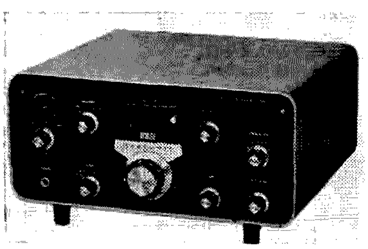
The HX-30 is a 6 meter SSB transmitter kit with 20 watts input on SSB, AM and CW. Phasing SSB, VOX, anti-trip, VFO, grid block keying. Size: 10⅛ h, 16⅝ w, 10 d. Weight: 50 lbs. Price: $189.95.



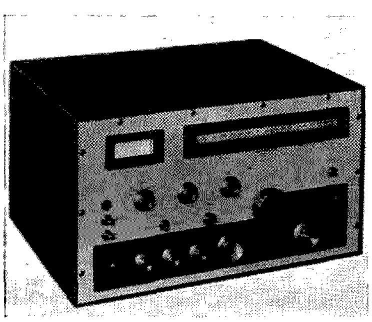
The RX-1 Mohawk is a 160-10 meter ham band receiver kit with calibrated scales for 6 and 2 meter converters. Product detector, T-notch filter, crystal calibrator, dual conversion, ANL, .5-5 kc selectivity, less speaker. Size: 11⅝ h, 19½ w, 16 d. Weight: 66 lbs. Price: $299.95, matching AK-5 speaker $10.95.



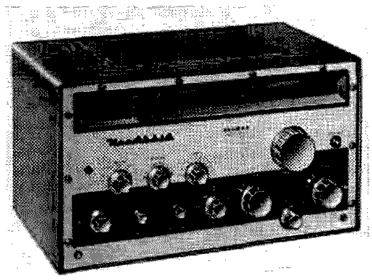
The SB-10 SSB adapter kit plugs into the TX-1 for conversion to phasing SSB with VOX and anti-trip. May be used with other transmitters. Size: 10 h, 6¾ w, 13 d. Weight: 12 lbs. Price: $93.50.



The SB-300 is an SSB ham band receiver kit for 80-10 meters. 1 kc calibration, crystal filter, variable AVC, crystal calibrator, .4-3.75 kc selectivity, linear tuning. Size: 6⅝ h, 13⅜ d, 14⅞ w. Weight: 17 lbs. Price: $264.95.



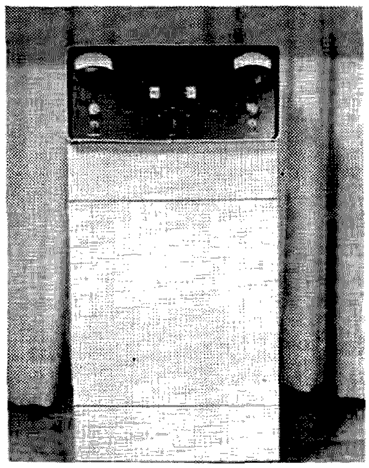
The TX-1 Apache is a 180 watt SSB and CW, 150 watt AM, transmitter kit to match the RX-1. 80-10 meters, provision for SSB adapter, speech clipping, timed sequence keying, 2-6146's in final, with power supply. Size: 11⅝ h, 19½ w, 16 d. Weight: 110 lbs. Price: $252.50.



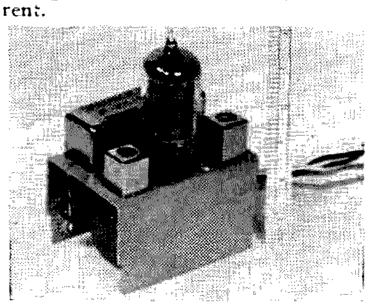
The VHF-1 Seneca is a 6 and 2 meter transmitter kit with 140 watt CW and 120 watt AM input to 2-6146's. VFO, 4 crystal sockets, carrier control modulation, bandswitching, power supplies included. Size: 10⅛ h, 16⅝ w, 10 d. Weight: 59 lbs. Price: $179.95.

Henry

Henry Radio
11240 West Olympic Boulevard
Los Angeles 64, California



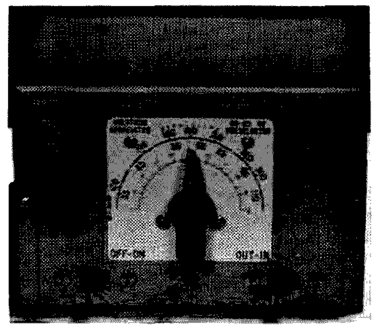
II-K linear amplifier. 2000 watts PEP input, 80-40-20-15-10 meters. 1 KW AM, CW, NFM, RTTY. Uses two 3-400Z Eimac zero bias triodes. 80-150 watts drive required. Size: rf section 10½" h, 14¾" w, 13½" d; power supply console 29½" h, 14¾" w, 13½" d. Weight: 158 lbs. Two panel meters for final plate voltage, plate current and grid current.



DMF-2 mechanical filter. An accessory for the Drake 2A and 2B receivers or any other 455 kc i-f receiver. Complete unit ready to mount in receiver to increase selectivity. Price $29.

Holstrom

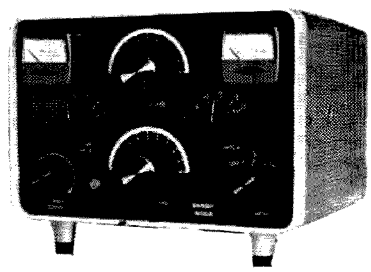
Holstrom Associates
P.O. Box 8640
Sacramento 22, California



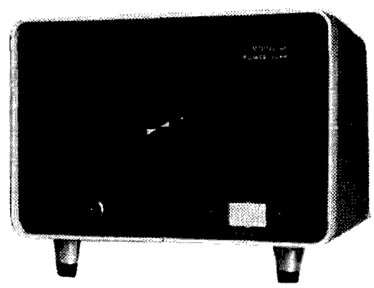
Model SK-20 preselector. Tunes 3.5-30 mc, built in power supply. $18.98

Hunter

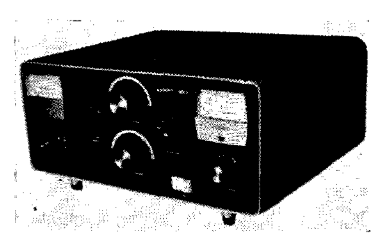
Hunter Manufacturing Company
Iowa City, Iowa



Bandit 1000A linear amplifier. Two UE572 zero bias triodes in grounded grid, 1000 watts PEP, 80-10 meters, rf output meter, 70-100 watts drive required, instant heating filaments good for mobile operation, power supply required, antenna relay built in, 9½"W, 7¾"H, 9"D, 11 lbs. $299.



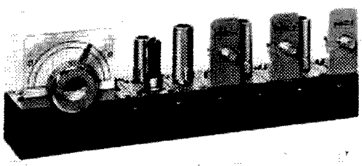
Model 60 power supply for 1000A $186.



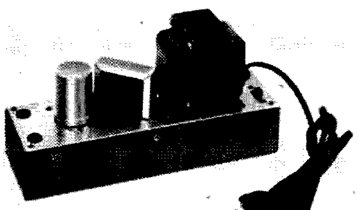
Bandit 2000A linear amplifier. Four UE572A's for 2000 watts PEP, 1000 watts CW, 80-10 meters, 160 watts drive required, rf output meter, internal antenna relay, built in power supply, 14¾" W, 6¾"H, 14"D, 45 lbs. $575.

International Crystal

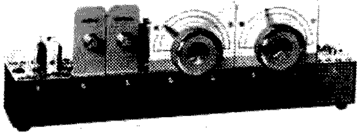
International Crystal Manufacturing Co., Inc.
18 North Lee
Oklahoma City, Oklahoma



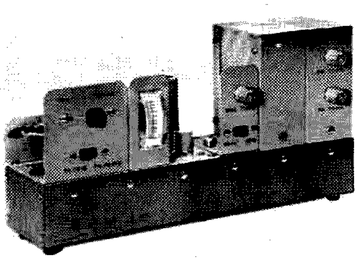
AOF VFO kit. 8-9 mc VFO for six and two meter transmitters. ½ watt output. AOF-89 includes VFO and buffer $22. AOF-90 includes multiplier for six meter output $29. AOF-91 includes multiplier for 6/2M output $36. 6BH6 osc., OB-2 VR, 12BY7 buffer-amplifier-multiplier.



AOP power supply kits. AOP-100 350 vdc 150 ma intermittent, 100 ma continuous, 6.3 vac @ 5 a, $18.50. AOP-200 650 vdc 250 ma intermittent, 200 ma continuous, 6.3 vac @ 10 a, $32.50.



AOR receiver kits. Superhet circuit (except for 150-450 kc model which is tuned rf) with regenerative second detector. Nuvistor rf amplifier. Additional Add-On-Circuits may be used to expand these basic receivers. AOR41-150-450 kc; AOR42 2-6 mc; AOR43 6-18 mc; AOR44 80/40 meter; AOR45 15/10 meter are all $62.50. AOR46 six meter; AOR47 two meter are $66.50. All AOR receivers include power supply and 4" speaker.



AOT-50 transmitter kit. 50W CW, 80/40M, 6DQ6. Includes meter, send-receive switch, xtal, less power supply. $35.00.

Irving

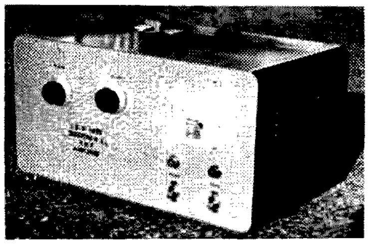
Irving Electronics Co.
P.O. Box 9222
San Antonio 4, Texas

The Hiverter 50 converts the output of any 14 mc transmitter to 50 mc AM, CW or SSB. 6146 final, pi-net output, less power supply. Size: 8 h, 10 w, 7 d. Price: $99.50.

The Preverter 50 and Preverter 144 are 6 and 2 meter transistorized preamplifiers. Band pass circuitry, silver plated chsasis. Price: $14.95.

J & D

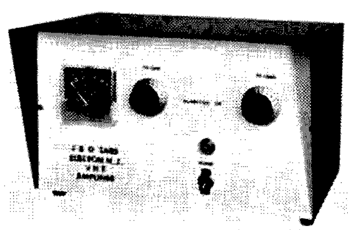
J & D Labs
P.O. Box 266
Eatontown, New Jersey



Model 500 linear amplifier, 4X150 final, built in silicon power supply, 500 watts SSB and CW, 250 watts AM. Single band unit, available for and band from 80 to 2 meters. Requires ten watts drive. $149.95.

Model 1000 linear amplifier. Same as model 500, only uses two 4X150's in the final for 1000 watts SSB and CW, 500 watts AM. Available for any band 80-2 meters. 7"H, 15"W, 9"D. $199.95.

Model 1062 linear amplifier, two 7034's, up to 900 watts AM & CW, 1000 watts PEP SSB. Covers both two and six meters. Requires only 5 watts drive. $199.95. Power supply for 1062 is $119.95.



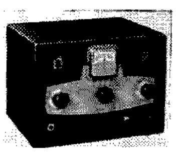
Musketeer Quad grounded grid four band (80-15 meters) amplifier. Power supply built in. Runs Eimac 3-400Z for full KW on SSB or CW and 600 watts on AM. Drives with any 70-250 watt exciter. 8"H, 12"W, 7"D. $329.90.

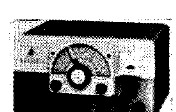
Musketeer Six, same as above but for six meters: $39.90.

Musketeer Two, same as Quad except for two meters: $319.90.

Johnson

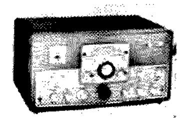
E. F. Johnson Company
Waseca, Minnesota

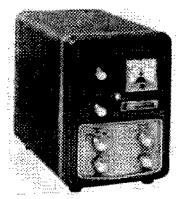




The Adventurer (left) is a complete Novice transmitter with 50 watts of CW input on all bands 80-10. It is crystal controlled and may be used with an external VFO and modulator. The 807 final is TVI shielded. Price: $69.95 in kit form only. Speech amplifier/modulator accessory kit, with tubes $12.25.

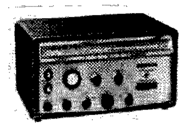
The Ranger II (right) is a 75 watt CW and 65 watt AM transmitter that covers all bands from 160 to 6 meters. The 15 tube circuit (6146 final) features VFO, plate modulation, timed sequence keying and TVI suppression. Power supply built in. The auxiliary socket may be used to power other equipment or drive a high power modulator. Size: 15½ w, 9⅝ h, 14 d. Weight: 43 lbs. Price: Kit, $249.50; Wired, $359.50.

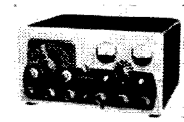




The Valiant II (left) is a 275 watt CW and SSB, 200 watts AM transmitter covering all bands 160-10. Provisions are included for an auxiliary SSB exciter. The 21 tube circuit features VFO, timed sequence keying, self contained power supply and TVI suppression. Size: 11½ h, 21 w, 14 d. Weight: 73 lbs. Price: Kit, $375; Wired, $495.

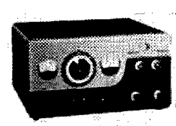
The Viking SSB Adapter (right) is a bandswitching filter type exciter for 80-10 meters designed for use with the Valiant or Valiant II. The 13 tube circuit includes an external power supply and needs only rf excitation and amplification from the transmitter. Size: rf unit 8 w, 11½ h, 14 d; power supply 3¾ w, 6¾ h, 7½ d. Total weight: 25 lbs. Price: $369.50 wired only.

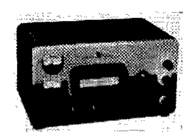




The Challenger transmitter, 120 watts CW and 70 watts AM, covers 80-6 meters. 7 tube circuit, 6DQ6A's final, screen modulator, shaped keying and crystal oscillator with provisions for external VFO. Built in power supply. Weight: 24 lbs. Price: Kit, $124.75; Wired, $169.75.

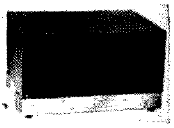
The Five Hundred is a complete 500 watt AM, 600 watt CW transmitter for the 80-10 meter bands. The 23 tube circuit features timed sequence keying, VFO, pi network output, TVI suppression and a PL175A final amplifier. An auxiliary SSB exciter will drive the transmitter to 500 watts. The rf chassis is 21 w, 11⅝ h, 16½ d; the power supply-modulator chassis is 20⅜ w, 15¾ h, 10⅞ d. Total weight: 173 lbs. Price: $1050 wired only.

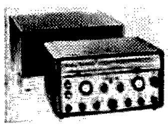




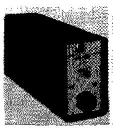
The Thunderbolt (left) is a 1000 watt linear amplifier covering 3.5-30 mc. It features a self contained power supply, 2-PL175A's, and less than 20 watts required drive. The one chassis is designed for table top operation. Size: 21 w, 11⅝ h, 16½ d. Weight: 120 lbs. Price: $659 wired only.

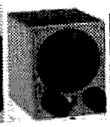
The Invader (right) is a 200 watt CW and SSB transmitter for the 80-10 meter bands. The 17 tube and 6 diode circuit includes VOX, anti-trip, filter sideband generation and self contained power supply. Size: 11⅝ h, 21 w, 17½ d. Weight: 53 lbs. Price: $619.50 wired only.

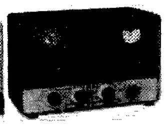




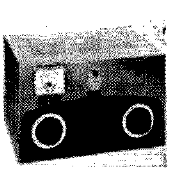
The Hi-power Converter converts the Viking Invader to the Invader 2000 to give 2 kw PEP SSB, 1 kw CW, or 800 watts AM. The kit includes new controls and panel for the Invader to make it identical to the Invader 2000. Size: 11¼ h, 19¾ w, 14½ d. Weight: 102 lbs. Price: $619.50.
The Invader-2000 combines all features of the preceding Invader and Hi-power converter in one complete transmitter. Sizes and weights are identical to each of the 2 preceding units. Price: $1229.

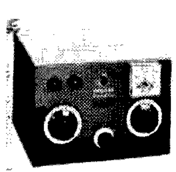






The 6N2 Converter (left) converts 6 and 2 meter signals to 1 of 4 *ifs:* 26-30 mc, 28-30 mc, 14-18 mc, 30.5-34.5 mc. Bandswitching and self contained power supply. Size: 5 h, 2¾ w, 12 d. Weight: 2 lbs. Price: Kit, $59.95; Wired, $89.95.
The 6N2 VFO replaces 8 to 9 mc crystals in any 6 or 2 meter transmitter. Includes a VR tube but requires external power. Size: 4 w, 5 h, 4½ d. Weight: 2 lbs. Price: Kit, $34.95; Wired, $54.95.
The 6N2 is a bandswitching transmitter for 6 and 2 meters. Requires an external power supply and modulator. 150 watts input CW, 100 watts AM to 5894. TVI suppression. May be driven by any 8-9 mc VFO or crystal. Size: 8⅜ h, 13⅛ w, 8½ d. Weight: 10 lbs. Price: Kit, $149.50; Wired, $194.50.
The 6N2 Thunderbolt amplifies a 5 watt input signal to 1200 watts PEP SSB, 1000 watts CW, or 700 watts AM. Silver plated tank circuits, 2-7034 final amplifiers, self contained power supply. Size: 21 w, 11⅝ h, 16½ d. Weight: 120 lbs. Price: $549.50 wired only.





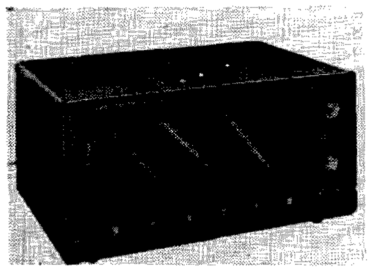
The Kilowatt Matchbox (left) provides all features of the 275 watt Matchbox plus a built in antenna change-over system. Size: 17¼ w, 10⅞ h, 12⅛ d. Weight: 27 lbs. Price: $154.50 with directional coupler.
The 275 watt Matchbox (right) matches 52 ohm coaxial input to 25 to 1500 ohm balanced or 25 to 3000 ohm unbalanced lines over the 3.5-30 mc range. Optional directional coupler gives continuous reading of SWR and relative power. Size: 9⅞ w, 10½ d, 7 h. Weight: 11 lbs. Price: $94.95 with directional coupler, $64.95 without.

Kolin

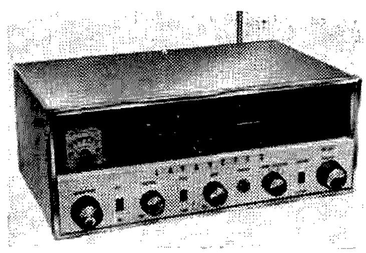
Kolin Engineering Company
Box 357
Bronxville, New York
The NL-1 and NL-2 are solid state noise limiters for tube and transistor receivers respectively. Silicon diodes, use with any diode detector. Price: NL-1 $7.95, NL-2 $9.95.

Lafayette

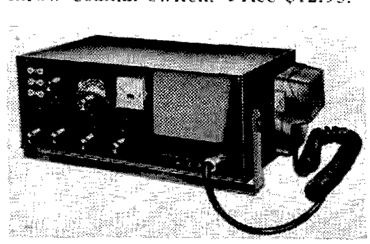
Lafayette Radio Electronics Corporation
111 Jericho Turnpike
Syosset, L. I., New York



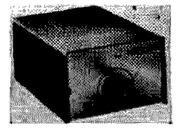
The HE-30 is a general coverage .55-30 mc receiver with calibrated amateur bandspread. Q-multiplier, S-meter, BFO, less speaker. Size: 7 h, 15 w, 10 d. Price: $99.95; HE-11 matching speaker $7.95.

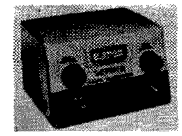


The HE-40 is a general coverage .55-30 mc receiver for the Novice or SWL. Electrical bandspread, AVC, S-meter, ANL, BFO, internal speaker. Size: 5⅞ h, 13½ w, 8¾ d. Weight: 12 lbs. Price: $49.95.
Model 351 is a double pole double throw coaxial switch. Price $12.95.

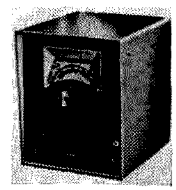


The HE-45-B a 6 meter transceiver with 14 watts input to a 2E26 final. Built-in 12 and 115 volt supplies and speaker. Pi-network, external VFO input, S-meter, spotting switch, noise limiter, superhet receiver. Size: 5 h, 12 w, 8½ d. Weight: 15 lbs. Price: $119.95. HE-50A is the same as the HE-45 except it covers 10 meters. $89.95.

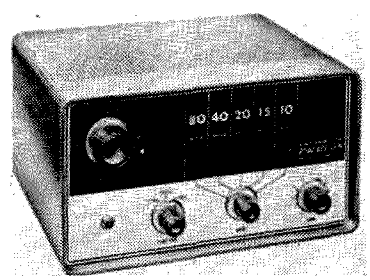




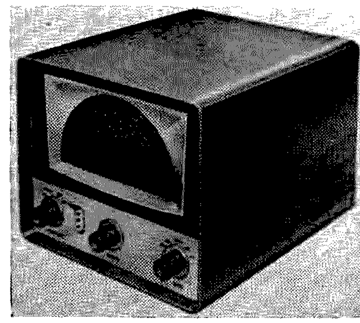
The HE-55 Squelcher (left) is a noise eliminator and squelch for use with all superhet receivers and transceivers. Reduces noise, quiets receiver under no-signal conditions, 2 tubes, takes power from receiver. Size: 2¼ h, 3 w, 4¼ d. Weight: 1 lb. Price: $10.95.
The HE-26 (right) is a hybrid phone patch for use with almost any transmitter and receiver. VU meter, gain control, complete switching. Size: 3½ h, 5½ w, 4 d. Weight: 3 lbs. Price: $22.50.



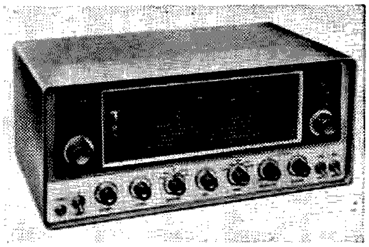
The HE-61A (left) is a 6 meter VFO with 8-9 mc output for use with most 6M transmitters and transceivers. 2 tubes, power cable, crystal plug, les power supply. Size: 3¾ w, 4¾ h, 4¼ d. Weight: 3 lbs. Price: $19.95.
Model HE-62 is the same except it covers 10 meters. Same price.
The HE-56 (right) and HE-71 are 6 and 2 meter converters, respectively, converting 50-54 mc and 144-148 mc to 7-11 mc. 2 tubes in HE-56, 3 in HE-71, self-contained power supply. Size: 7⅝ h, 3½ w, 5⅝ d. Weight: 6 lbs. Price: HE-56, $29.95; HE-71, $32.95.



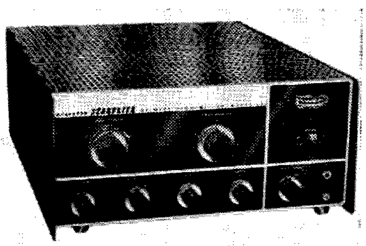
The HE-73 is a preselector and converter for 80-10 meters. Preselector only on 80 and 40, preselector or converter on 20, 15 and 10. Converts to 80 meters, self powered, gives 22 to 36 db gain. Size: 6 h, 10 w, 8 d. Price: $49.50.



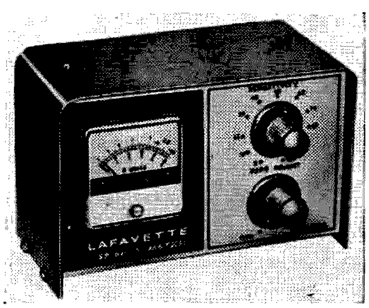
The HE-74 Starchief is a VFO for 80-6 meters with output to drive most amateur transmitters. 4 tubes plus self-contained power supply, crystal socket, output voltage to 20 volts. Size: 7¾ h, 8¾ w, 10 d. Weight: 10 lbs. Price: $44.50.



The HE-80WX is a communications receiver for .55-30 and 48-54 mc with calibrated amateur bandspread 80-10. 14 tubes, product detector, S-meter, crystal calibrator, Q-multiplier, ANL, less speaker. Size: 7½ h, 17 w, 10 d. Price: $149.50.



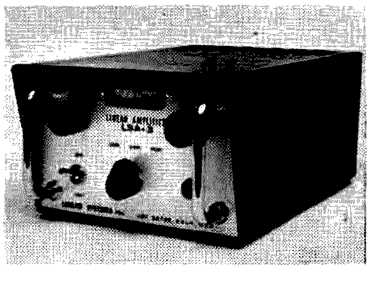
The KT-390 Starflite is a 80-10 meter transmitter kit with 90 watts input to a 6146 on CW or carrier-controlled AM. Grid-block keying, low-pass filter, pi-network output, internal silicon power supply. Weight: 25 lbs. Price: $79.50.



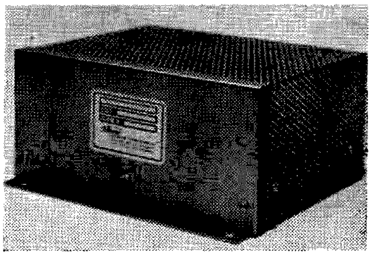
The TM-59A is an S-meter for use with any superhet receiver with AVC. Wheatstone bridge circuit, 4 connecting leads, calibrated to 30 db over S9. Price: $7.95.

Linear Systems

Linear Systems Inc.
605 University Avenue
Los Gatos, California

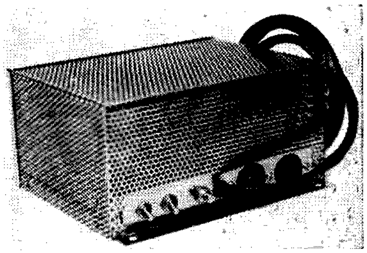


LSA-3 Broadband Linear Amplifier. Uses four GE 7984's in parallel for 500 watts input, 20-40-80 meters bandswitching, separate matching power supply, 25 watts drive, for shack or mobile use. 4½"H, 6½"W, 10"D, 5¼ lbs. Pi-net 50 ohm output. Price is $150. With ac or dc supply $249.50.



Adcom 350-12, dc to dc transistorized converter. 4½" x 6½" x 8", 8 lbs. 12 vdc to 800 v @ 400 ma or 600 v @ 500 ma and 275 v @ 200 ma. Also 0-110 v @ 30 ma neg adj bias. Provides power for most sideband transceivers on market: TR-3, SR-150, Galaxy 300, Swan, KWM-2, etc. Price $125.
Adcom 500, dc to dc transistorized converter. 13 vdc input to 1250 v @ 400 ma, 300 v @ 200 ma, 90 v dc neg zener regulated, adj 0-90. 4½" x 7" x 9". 9 lbs. $150.
Adcom 1000, dc to dc transistorized converter. 13 vdc input gives 2250 v @ 450 ma, 300 v @ 100 ma, 0-110 v neg adj bias, 0-90 v adj bias. 4½" x 7" x 9", 15 lbs. $250.

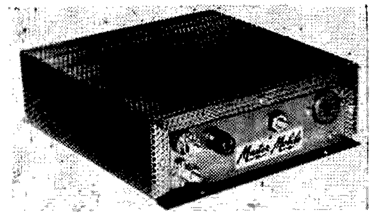
Adcom 350-ac. 117 vac 50/60 cycle input, 800 v @ 400 ma or 600 v @ 500 ma and 275 v @ 200 ma, 0-110 v neg adj bias, 6.3 vac 6A, 12.6 vac 6A, 12.0 vdc @ 200 ma. 4" x 6½" x 8". $99.50.
INV-12150. Input 12 vdc (to 15 vdc), output 120 vac 60 cycle squarewave. 150 watts continuous, 4" x 4" x 6", 6½ lbs. $60.



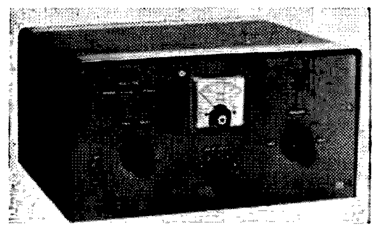
INV-12400. Input 12-15 vdc, output 120 vac 60 cycle squarewave. 400 watts peak, 300 watts continuous, 4½" x 7" x 9", 16 lbs. $119.50.

Master Mobile

Master Mobile Mounts, Inc.
4125 West Jefferson Blvd.
Los Angeles 16, Calif.



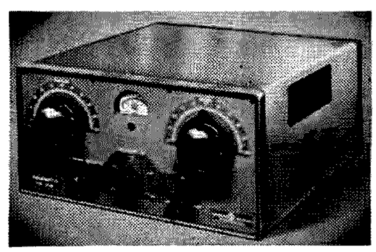
The MPS-800 and MPS-1250 power supplies deliver high voltage dc from 12 vdc input. Size: 2¾ h, 8 w, 9 d. MPS-800 has outputs of 800 v at 275 ma, 300 v at 150 ma and -90 v bias. Price: $119.50. MPS-1250 has outputs of 1250 v at 400 ma, 300 v at 150 ma and -90 v bias. Price: $139.50.



The K-73 linear amplifier for mobile SSB runs 750 watts PEP to 2-811A's on 80-10 meters. Self contained power supply, 50 watts drive, pi-net output. Size: 6½ h, 13½ w, 12½ d. Weight: 15½ lbs. Price: $289.50, RC-73 remote control $17.95.

Millen

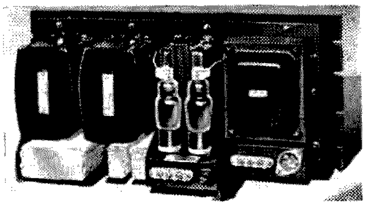
James Millen Mfg. Co., Inc.
Malden, Massachusetts



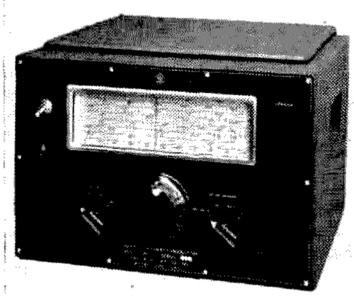
The #92200 Transmatch is an antenna coupler with reflectometer to couple 52 ohm input to 10-1000 ohm coax output. Handles 2 kw, bandswitching 80-10 meters. Size: 7 h, 14 w, 13⅝ d. Weight: 17 lbs. Price: $129.50.
The #90932 transmitter monitor is bandswitching 80-6 meters using a 2" scope tube. Beam blanked in standby, envelope or trapezoid pattern. Size: 7¼ h, 5½ w, 11 d. Weight: 8 lbs.
The #90801 transmitter provides 90 watts input CW, 67 watts phone to a 6146. Covers 80-10, TVI shielding, 5 meter scales. With one set of coils, less tubes, power supply, VFO and modulator. Size: 3½ h, 19 w, 9 d. Price: $75.00.

The #90831 modulator will plate modulate most transmitters up to 110 watts. 4000 ohm output, pr 6146's

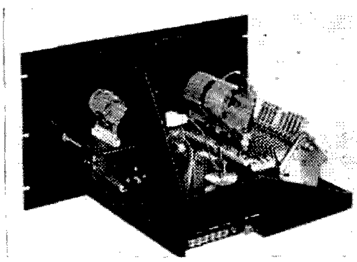
less tubes and power supply. Size: 3½ h, 19 w, 6 d. Price: $60.00.
The #90811 amplifier gives 110 watt CW or 85 watt phone output on 20-2 meters. Plug in coils, 829B final. Less power supply, tube, modulator and meters. Price: $45.00.



The #90281 power supply provides 700 vdc at 235 ma and 6 vac at 4 amps. 2-816's, 2 section filter, less tubes. Size: 8¾ h, 19 w, 8 d. Weight: 56 lbs. Price: $94.50.
The #90201 power supply delivers 250 vdc at 115 ma, 105 vdc regulated at 35 ma, and 6.3 vac at 4.2 amps. Price: $52.50.



The #90711 VFO covers 80-10 meters with a built-in power supply. 3 tubes, rectifier and regulator. Size: 9¼ h, 12¾ w, 12 d. Weight: 26 lbs. Price: $124.50.



The #90881 is an rf power amplifier using plug in coils for 160-10 meters. 520 watts to 2-812A's, less power supply and tubes. Size: 10½ h, 19 w, 13 d. Weight: 13 lbs. Price: $100.50.

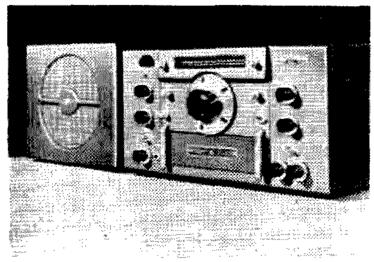
Mosley

Mosley Electronics, Inc.
4610 North Lindbergh Boulevard
Bridgeton, Missouri

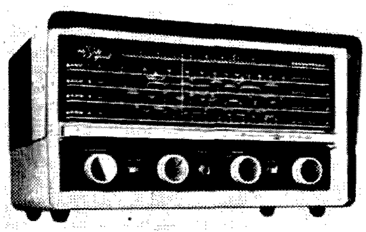
Model CM-1 receiver. 80-10 meters, double conversion, AM and SSB detectors, S-meter, separate speaker, ANL, 10½" x 7½" x 8" d. $182.70. Matching speaker $16.95.

National

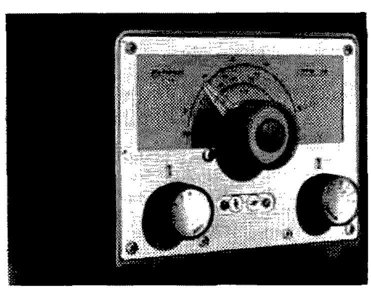
National Radio Company, Inc.
Melrose 76, Mass.



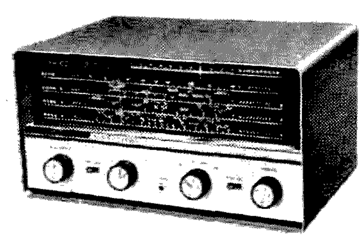
The HRO-60 is an 18 tube receiver for 50-430 kc and .48-54 mc. Coils are furnished for 1.7-30 mc, others extra. Slide rule dial, double conversion, selectivity to 100 cycles, 8 watts audio, 110 or 220 vac supply. Less speaker. Size: 10⅛ h, 19¾ w, 16 d. Weight: 88 lbs. Price: $975, matching speaker $29.95.



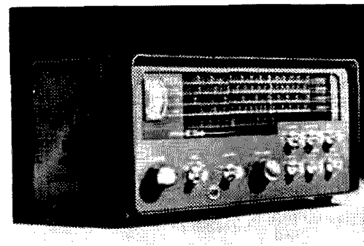
The NC-60B is a Novice or SWL general coverage receiver covering .54-31 mc in 4 bands. Built in speaker, 5 tubes, electrical bandspread, BFO. Size: 7⅝ h, 13½ w, 8⅝ d. Weight: 15 lbs. Price: $59.95.



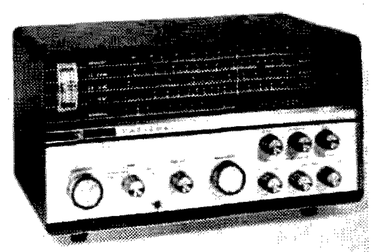
The VFO-62 is a 8-9 mc vfo for use with any 6 or 2 meter transmitter. Self powered, crystal socket, bandswitching, spotting switch. Size: 5¼ h, 6½ w, 5½ d. Weight: 6 lbs. Price: $49.95.



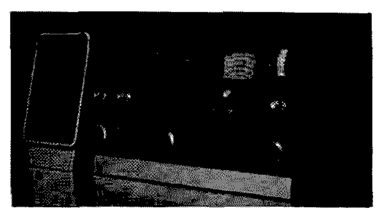
The NC-77X is a general coverage receiver for the SWL or Novice. 4 bands, .54-31 mc, built in speaker, transformer operated, electrical bandspread. NC-77XW has walnut cabinet. Size: 7⅝ h, 13½ w, 9 d. Weight: 18 lbs. Price: NC-77X, $69.95; NC-77XW, $89.95.



The NC-105 is a general coverage receiver, tuning .55-30 mc in 4 bands. Q-multiplier, S-meter, electrical bandspread, product detector, tuner output. NC-105W has walnut cabinet. Size: 7⅝ h, 13½ w, 8⅝ d. Weight: 27 lbs. Price: NC-105, $119.95; NC-105W, $139.95.

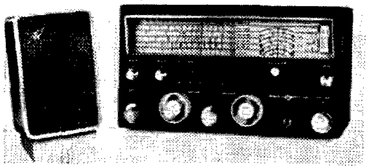


The NC-121 is a general coverage receiver, tuning .55-30 mc in 4 bands. Logging scale, Q-multiplier, tuner output, BFO, noise limiter, built in speaker. NC-121W has walnut cabinet. Size: 7⅝ h, 13½ w, 9 d. Weight: 28 lbs. Price: NC-121, $129.95; NC-121W, $149.95.

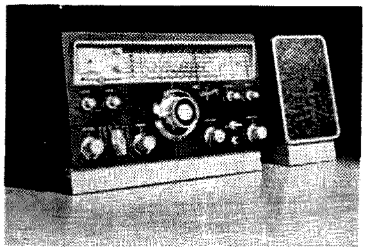


The NC-140 is a general coverage receiver for .54-31 mc in 5 bands with calibrated amateur bandspread. Dual conversion above 4 mc, Q-multiplier, noise limiter, product detector, less speaker. Size: 8⅝ h, 15⅝ w, 9 d. Price: $189.95.

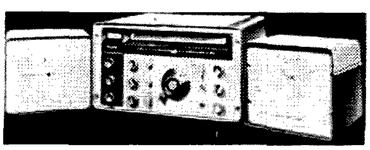
The NC-155 is a ham band receiver for 80-6 meters. Dual conversion, S-meter, .6-5 kc selectivity, product detector, less speaker. Size: 8⅝ h, 15⅝ w, 9 d. Weight: 28 lb. Price: $199.95.



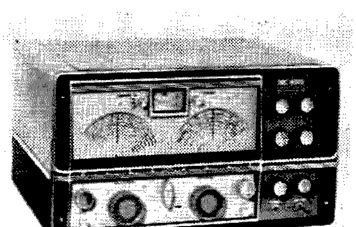
The NC-190 is a general coverage .54-30 mc receiver with amateur bandspread. Double conversion above 4 mc, noise limiter, .6-5 kc selectivity, product detector, 5 bands, less speaker. Size: 8¾ h, 15¾ w, 9 d. Weight: 28 lbs. Price: $219.95.



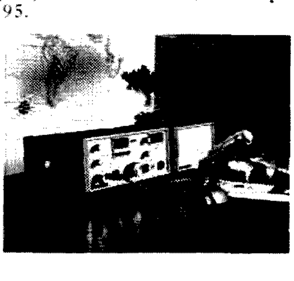
The NC-270 is a ham band receiver for 80-6 meters. .6-5 kc selectivity, S-meter, noise limiter, crystal calibrator, product detector, T-notch, selectable sideband, less speaker. Size: 8⅝ h, 15⅝ w, 9 d. Weight: 28 lbs. Price: $279.95; matching NTS-3 speaker $19.95.



The NC-303 covers 160-10 meter ham bands only; 6, 2 and 1¼ meter scales for use with accessory converters. .4-8 kc selectivity, noise limiter, Q-multiplier, double conversion, selectable sideband, voltage and current regulation, less speaker. Size: 19¼ w, 11¼ h, 15 d. Weight: 64 lbs. Price: $449; matching NTS-2 speaker $21.95.



The NC-400 covers .54-31 mc in 7 bands, with amateur bandspread for 80-10. Product detector, logging scale, S-meter, 150 cycle to 16 kc selectivity, optional crystal control and mechanical filters. Size: 19¼ w, 11¼ h, 16 d. Price: $895. Speaker $21.95.



The NCX-3 is a transceiver for 80, 40, and 20 meters. 200 watts PEP SSB, 180 watts CW, 100 watts AM, VOX, push-to-talk, grid block keying, S-meter, product detector, filter SSB, 2.5 kc selectivity. Less power supply and speaker. Size: 6 h, 13⅝ w, 11⅜ d. Weight: 25 lbs. Price: $369.95. AC supply/speaker, $110; 12 vdc supply, $119.95.

Parks

Parks Electronics Laboratory
Route 2, Box 35
Beaverton, Oregon

The Model 50-1 6 meter converter uses a 6CW4 and 6U8A to give output on 7-11, 10-14, 14-18, 26-30, 27-31, 28-32, or 30.5-34.5 mc. 1.5 mc bandwidth, self-contained power supply, choice of connectors. Price: $34.50.

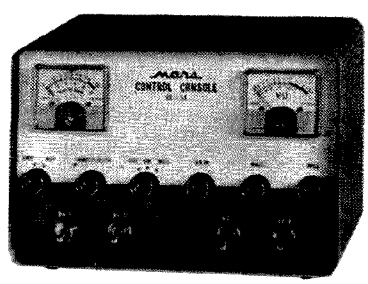
The 144-1 is a cascode nuvistorized 2 meter converter with possible *if*s of 7-11, 10-14, 14-18, 22-26, 24-28, 26-30, 27-31, 28-32, 30.5-34.5 or 50-54 mc. 4 mc bandwidth, choice of connectors, 3 db noise figure, power supply included. Price: $54.50.

The Model 25 code wheel sends VVV or CQ and your call at 8 wpm. Switching between wheels and key jack. Includes 4 blank discs. Price: $25.00. Extra discs 3/$1.00.

The 144-1P 2 meter preamplifier uses 2 nuvistors to give a 2.5 db noise figure. Built-in power supply, 4 mc bandwidth, UHF connectors. Price: $25.00.

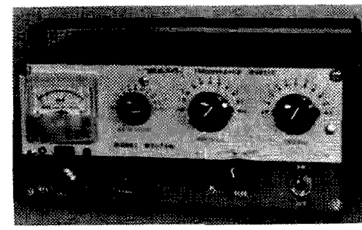
Pausan

Pausan Company
Mars Amateur Radio Division
P. O. Box 946
San Rafael, Calif.



The CC-12 control console contains a speaker, phone patch, VU meter, kw SWR bridge, and blank switches. Size: 6½ h, 9½ w, 7 d. Price: $57.50.

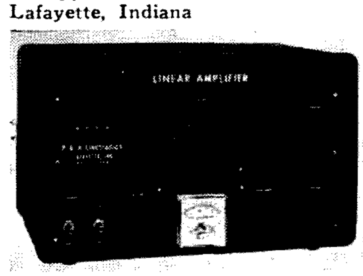
The EK-20 is an transistorized electronic keyer with built-in ac power supply. Monitoring audio, speaker, 10-50 wpm. Price: $29.95.



The MT-75A mobile transmitter operates on 80 or 40 with 18 watts input. Less power supply. Size: 3½ h, 7½ w, 5 d. Price: $59.50.
The SP-1000 2 kw PEP SSB linear uses 4-811A's, 2-866's for legal limit. 50-75 watts drive, grounded grid, built-in supply, pi-output, less tubes. Price: $299.50.
The Mars phone patch can be used on AM or SSB. Hybrid circuit, rf filters, gain controls, VU meter. Price: $27.95.
The Mars SWR bridge measures SWR in 50 or 75 ohm lines. Price: $17.95.
The Mars transistorized oscillator-monitor uses rf pickup for monitoring. Self-contained battery supply. Price: $14.95.

P & H

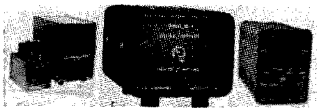
P & H Electronics, Inc.
424 Columbia Street
Lafayette, Indiana



LA-400C Linear amplifier. 80-10 meters, four converted 1625's in grounded grid, 800 watts PEP on SSB, 400 watts CW, 230 watts AM controlled carrier linear AM, 185 watts AM constant carrier, built in power supply, 20-100 watts drive required, metered, 9" x 15" x 10½", 55 lbs., $179.95 in kit form, $219.95 wired.

LA-500M "Spitfire" linear amplifier. 80-10 meters, six 12JB6's in grounded grid, 1000 watts PEP on SSB, mobile or fixed, uses separate power supply, 3" x 12" x 15", 14 lbs, built in antenna switching. $189.95.
Model PS-1000, 115 vac supply for LA-500M $119.95.
Model PS-1000B, 12 vdc supply for LA-500M $179.95.

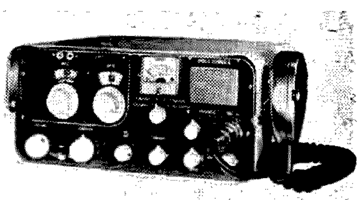
2-150 transmitting converter. Converts 20 meter output of any exciter (AM-SSB, etc.) to two meters. 7854 final, 175 watts PEP on SSB, 165 watts CW, 90 watts linear AM. Built in power supply. 9" x 15" x 10½", 45 lbs. 10-100 watts drive required. Well metered. $329.95.
6-150 transmitting converter. Almost the same as the 2-150 except converts 20 meters to six meters, final 8117. Price $299.95.



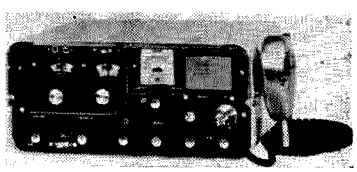
The AFC-1 and AFC-2 audio compressers (left) provide avc-type compression to 50 db. AFC-1 less power supply, 3 w, 5 h, 3 d. AFC-2 with power supply and 3 steps audio selectivity, 7 h, 5 w, 5 d. Price: AFC-1 $32.95, AFC-2 $54.95.
The AR-1 antenna transfer unit (center) automatically transfers transceiver output to linear during transmit, to antenna during receive. Size: 3 h, 4 w, 4 d. Price: $32.50.
The DI-1 rf distortion indicator (right) displays a trapezoid or envelope pattern on a 3" tube. 160-6 meters, 5 watts to 2 kw. Price: $99.95, TT-1 two-tone oscillator $19.95.

Polytronics

Polytronics Laboratories, Inc.
88 Clinton Road
West Caldwe'l, New Jersey 07007



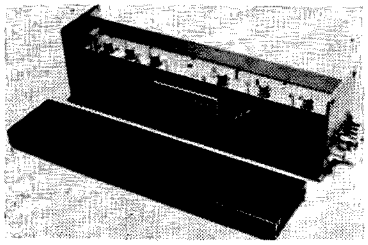
The Poly-Comm 6 transceiver covers 50-54 mc with 10 watts output. Nuvistor front end, squelch, noise limiter, S-meter. Weight: 23 lbs. Price: ac only $309.50, ac/12vdc $329.50.



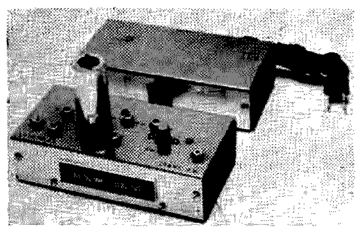
The Poly-Comm 2 transceiver covers 144-148 mc with over 7 watts output. Nuvistor front end, squelch, noise limiter, S-meter, triple conversion, 10 diodes, 19 tubes. Weight: 23 lbs. Price: ac only $329.50, ac/12vdc $349.50.

Redline

Red'ine Company
Jaffrey, New Hampshire
ply. $? Redline 2X3=1¼ tripler. Feed output of 144 mc transmitter into this unit and out comes 432 mc. Five watts input give three watts output. No power supply required. $? Redline 1296'er. Transmitting tripler, taking 432 mc and converting it to 1296 mc. Three watts input at 432 give one watt output at 1296 mc. $? Redline ABC2NP preselector. All band cascode two nuvistor preamplifier, tunes 160 thru 6 meters. $22.95.



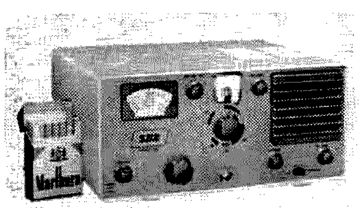
Redline DGC- converters. Available for 50, 144, 220 mc. Custom made converters, any specified output frequency. Built in extruded aluminum channel for double shielding. Designed to thwart images, cross-modulation. All nuvistorized (six). Can be used as is or mounted on 3" rack panel. $98.50. Power supply for DGC converters with voltage regulation, special filtering. $49.50.



Redline HJC-50 converter. Broadband converter for 50-54 mc. Nuvistor front end. Output 14-18 mc. Crystal controlled. Requires separate power supply or can be powered from receiver. $31.95. Matching power supply with mating plug. Model HJS $9.95. Redline HJC-144 converter, 144-148 mc, crystal controlled converter, nuvistor front end, output 14-18 mc. Built in power sup-

SBE

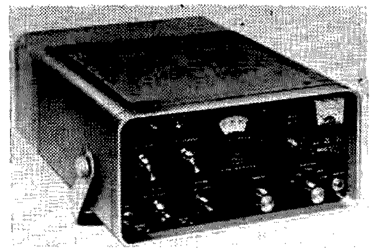
Sideband Engineers Inc.
Rancho Santa Fe, California



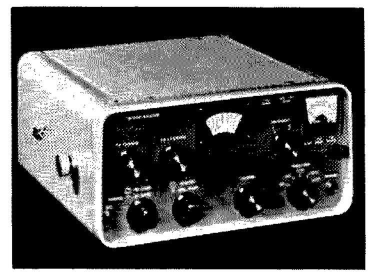
Model SB-33 sideband transceiver. Selectable single sideband on phone segments of 75-40-20-15 meters, transistorized except for higer power rf stages, final 2-PL500's. 2.1 kc Collins mechanical filter, ac power supply and speaker built in, 5½"H, 11¾"W, 10¼"D, 15 lbs. $389.50. DC to ac inverter $59.50.

Sonar

Sonar Radio Corporation
73 Wortman Avenue
Brooklyn 7, New York



Four Bander. Sideband transceiver for 15-20-40-75 meters, 200 watts PEP, 180 watts CW, xtal calibrator; connections for phone patch, Q-multiplier, sidetone, break-in CW. $495. AC supply $99.50. AC supply with speaker $135. DC supply $135.



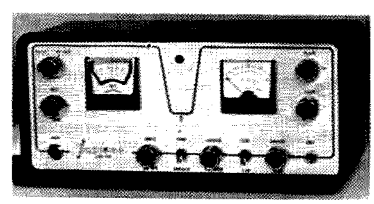
Monobander. Individual transceivers available for all amateur bands 80-10 meters, VOX, PTT, S-meter, AMC, 2.1 kc Collins mech. filter. $395.

Steel Tex

Steel Tex Electronics, Inc.
30210 West 8 Mile
Farmington, Michigan
The W8IRO terminal unit connects to receiver speaker and printer magnets for no control TU operation. Built-in power supply, pre-set mark and space, limiting circuit. Price: $25.00.

Supreme

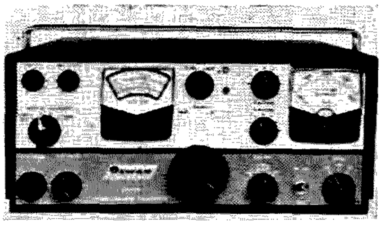
Supreme Electronics Inc
Front and Main Streets
Upland, Pennsylvania



SSB-6B six meter sideband transmitter. 75 watts PEP, 8 watts AM, McCoy crystal filter, 50-54 mc, VFO covers 50.0-50.3 mc, 6146 output. Separate power supply required. $289.50.
SB6-LA six meter linear amplifier. 32 watts drive required, 3-400Z 2000 watts PEP input, 600 watts AM, requires power supply, 15"W, 6½"H, 9"D, 15 lbs. Fully metered. $229.50. PS-1 matching power supply, solid state, $199.50.

Swan

Swan Engineering Co.
Oceanside, California



The SW-240 is an 80, 40 and 20 meter transceiver with 240 watts PEP SSB, 200 watts CW, 60 watts AM to a 6DQ5. Pi-net, AGC, 15 tubes, crystal bandpass filter. Size: 5½ h, 13 w, 11 d. Weight: 12 lbs. Price: $320, SW-12DC supply $115, SW-117AC supply with speaker and cabinet $95.

Tecraft

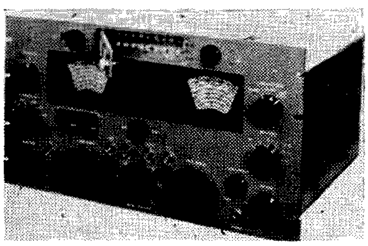
The Equipment Crafters
Box 84
South Hackensack, N. J.

The Criterion converters are available for 50-54, 144-148 and 220-225 mc. Outputs available from 6-50 mc, built-in power supply, 2 tubes, 2 nuvistors, 4 mc flat bandpass. Price: $49.95.

The Tecraft transmitters are available for 50, 144 and 220 mc. All include one crystal and have 6360 final at 20-25 watts input. Plate modulation, less power supply. Price: $59.95, power supply $39.95.

TMC

The Technical Material Corporation
Mamaroneck, New York



The GPR-91 communications receiver covers .54-31 mc in 6 bands with calibrated 160-10 bandspread. 1 uv sensitivity, 250 cycle to 15 kc selectivity, crystal calibrator, noise limiter, dual conversion, S-meter. Size: 10½ h, 19 w, 14 d.

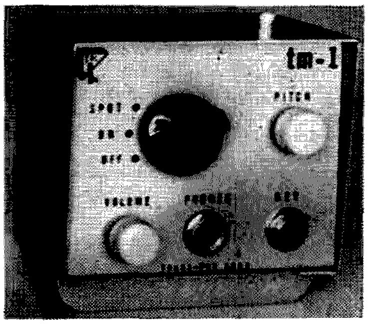
Topaz

Topaz Transformer Products Inc.
3802 Houston St.
San Diego 10, California

The 300XL univerter is a dc/dc converter for 12 volt input and 600, 700, 800, 275 volts + and 50 to 90 volts — output. 300 watts, transistorized, with cable and leads. Size: 6½ h, 5 w, 4¾ d. Weight: 8 lbs. Price: $119.95.

Trans-Pro

Transistor Products Laboratories
263 Bouchard Avenue
Dracut, Mass.



The TM-1 CW monitor uses 4 transistors and 2 diodes to mute receiver output and inject a sidetone. Pitch and volume controls, no alterations to rig, full break-in, also a code-practice oscillator. Size: 4½ h, 4⅛ w, 3½ d. Price: $19.50.

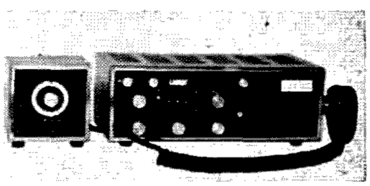
Tri-State

Tri-State Electronics Inc.
2734 Lee Highway
Falls Church, Virginia

The Tri-X 500 transmitter has 500 watt SSB and CW input, 250 watts AM. Built-in power supply, ALC, VOX, anti-trip, pi-network, blower, 7034 final. Solid state p.s., Break-in keying, $795.

Utica

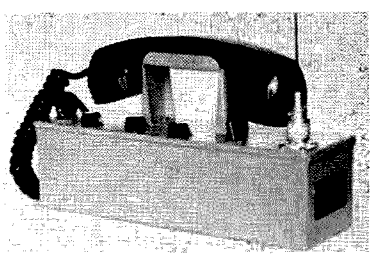
Utica Communications Corp.
2917 W. Irving Park Road
Chicago 18, Illinois



The Utica 650 is a 6 meter transceiver with VFO included. It features 22 watts input to a 2E26, 3 kc selectivity, dual conversion, spotting switch, S-meter, adjustable BFO, built in power supplies for 12 and 120 volts. ANL, push to talk, microphone, ac power cord. Price: $189.95. 12 vdc power cord $3.95.

Vanguard

Vanguard Electronic Labs
190-48 99th Avenue
Hollis 23, N. Y.



The Vanguard Mark 2 walkie-talkie is crystal controlled on 26.5-30 mc channels. 200 mw output, 8 "D" batteries, 24" whip, handset. Size: 6½ h, 11 w, 3¼ d. Weight: 4¼ lbs. Price: $79.98, wired TR-28 kit $24.98 to $54.98. The Mark 3 transceiver is identical to the Mark 2 except for 49.5-54.5 mc frequency coverage. Price: $69.95.

photo V-2

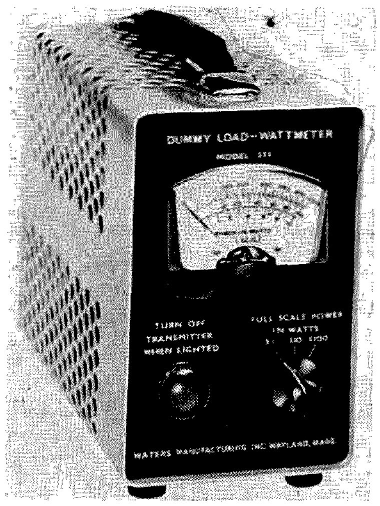
The TNS noise silencer is a combination squelch and noise silencer for home or mobile use. Price: $6.00.

The Model 300 converters use 3 transistors for the VHF bands. 300-B has 50-51 mc in, .6-1.6 mc out, price $8.50. 300-C has 50-54 mc in, 14-18 mc out, price $8.50. 300-D has 144-148 mc in, 50-54 mc out, price $10.50.

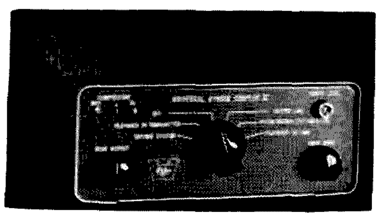
The Vanguard nuvistor converter uses a 6CW4 pre-amp and 6U8A converter. .1 uv sensitivity, output on 14-18 mc or .6-1.6 mc. Price: $10.00.

Waters

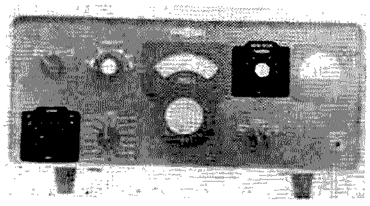
Waters Manufacturing Company
Wayland, Massachusetts



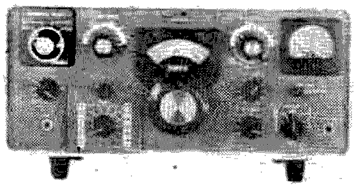
Model 334 Dummy Load. Non-inductive load, 2-230 mc, 52 ohms, 250 watts continuous, 1000 watts intermittent with warning light when load temperature reaches safe maximum. Calibrated scales: 0-10, 100, 1000 watts. 4¾" x 9" high x 10¼" long. 12 lbs. Amateur Net: $79.75.



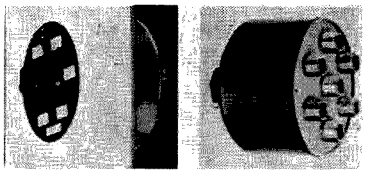
Universal Hybrid Coupler II. Phone patch or tape recorder matching unit with built in compressor and hybrid circuit for sideband operation. Model 3002. Net $69.95. Kit available to modify previous hybrid coupler Model 3001 to 3002: $19.95.



Q-Multiplier/Notch Filter for Collins 75S1. Mounts without damage to equipment, exactly matching. Eliminates heterodynes and unwanted signals from passband. Model 337-S1A for 75S1 $39.95.



Q-Multiplier/Notch Filter for Collins KWM2/2A transceivers. Does same job as above unit. Model 340-A $53.75.



Coaxial Switches. Model 335 (illustrated) switches one pole six position for antenna selection, etc. SO-239 type connectors come straight out rear of switch for ease of cabling. Comes with escutcheon and matching knob. $12.95. Model 341 is a single pole double throw switch and sells for $11.45. Model 336 is a coaxial transfer switch for feeding an exciter to a final or bypassing the final, price $11.45.

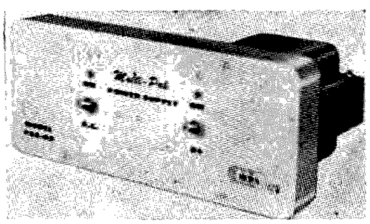
Whippany

Whippany Laboratories, Inc.
1275 Bloomfield Ave.
West Caldwell, N. J.

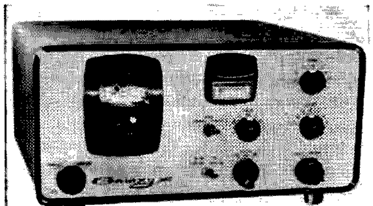
The Li'l Lulu 6 meter transmitter has VFO coverage 50-54 mc, voltage regulation, shaped keying, built-in 12 vdc and 117 vac power supplies, low-pass filter.

WRL

World Radio Laboratories
3415 West Broadway
Council Bluffs, Iowa

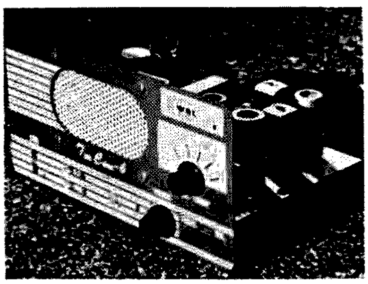


The PSA-63 is an ac power supply to power any 50-100 watt transmitter or transceiver. 600 vdc, 300 vdc, or combination to 210 watts. 6 or 12 volt filament windings, 95 volt bias winding. Less cabinet, accessory kits available to modify for use with various rigs. Size: 4¾ h, 6 d, 11¼ w. Weight: 15 lbs. Price: Kit $24.95, Wired $39.95.



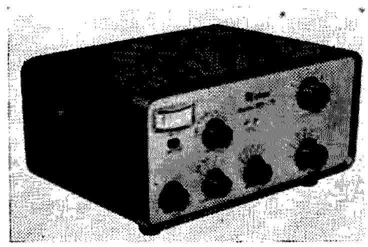
The Galaxy 300 is a 200 watt PEP SSB transmitter for the phone sections of 80, 40 and 20 meters. 2.7 kc selectivity, 35 watts AM, two speed tuning, push to talk, audio AVC, ALC, S-meter, less VOX and power supply. Size: 7 h, 15 w, 13⅝ d. Weight: 27 lbs. Price: $299.95; ac power supply with clock $99.95, less clock $79.95; dc supply $119.95; accessory VOX $19.95; mobile bracket $15.00.

The MM-100 Mini Matcher is an antenna tuner kit for use with transmitters with inputs to 100 watts. Matches 52-75 ohm coax to multiple half wave end fed antennas. Size: 4 h, 5 w, 4 d. Price: $10.95.

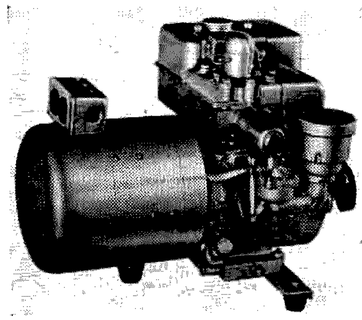


The TechCeiver-6 is a 6 meter transceiver with 1 watt output. Crystal controlled, push to talk, plate modulation, 6 tubes, speaker included, less power supply. Size: 5 h, 9¼ w, 6 d. Weight: 5¼ lbs. Price: $39.95, ac supply $15.95.

The SS-3 Q-multiplier kit can be used with any receiver with a 455 kc *if*. Internal power supply, selectivity to 300 cycle peak or notch. Size: 4¼ h, 6¼ w, 4¾ d. Price: $15.95.

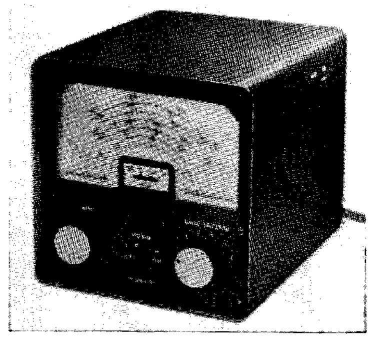


The SB-175 Meteor transmitter operates on 80-10 meters with 175 watts DSB or CW, 100 watts AM. Pi-network, audio limiting. Less power supply. Size: 5 h, 12 w, 8 d. Price: $99.95.



The 12A generator delivers 120 vac at 1250 watts full load. 2 pole generator, rope starter, 4 cycle motor, holds 3 qt gas, 1¼ pt oil, air cleaner. Weight: 100 lbs. Price: $149.95.

The SW-59 is a general coverage .54-35 mc communications receiver with calibrated amateur bandspread. Noise limiter, speaker, S-meter, wood cabinet, transformer power supply. Price: $39.95.



The DB-68 pre-amplifier has 3 tubes and power supply for coverage of 80-6 meters. Coax or twin-lead connections. Size: 6¾ h, 6¾ w, 7½ d. Price: $39.95.

If manufacturers have any changes, corrections or additions to this list they are welcome to bring them to our attention. Should this section meet with any great acclaim we will plan on repeating it next fall again.

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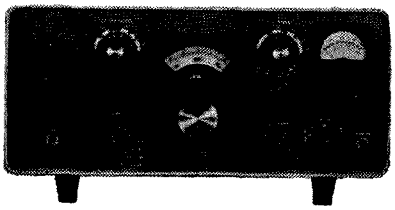


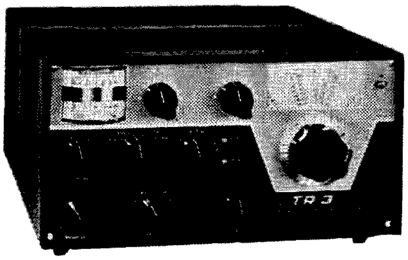
COLLINS

KWM-2 $1150

516-F2 ac supply $115

351-D2 mntg rack $120

MP-1 dc supply $198



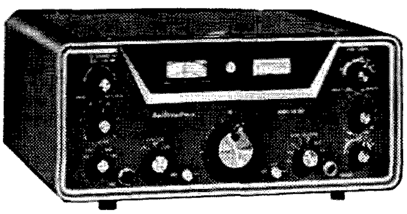
DRAKE

TR-3 $495

AC-3 ac supply $79.95

DC-3 dc supply $129.95

Speaker $19.95



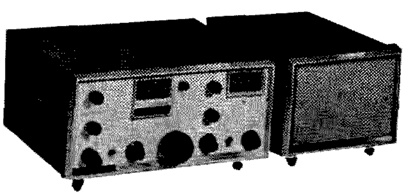
HALLICRAFTERS

SR-150 $650

P-150 ac supply $99.50

P-150 dc supply $109.50

MR-150 mntg rack $39.95

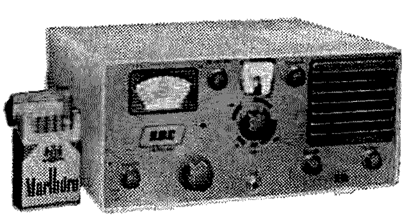


NATIONAL

NCX-3 $369

NCX-A ac supply $110

NCX-D dc supply $119.50



SBE

SB-33 $389.50

ac supply built in

dc supply $59.50

mntg rack $12.50

SWAN

SW-240 $320

SW-117 ac supply $95

SW-12 dc supply $115

Write today for our special "Transceiver Packet" containing full data on these leading brands, our new equipment catalog #163, just out, and our latest used gear bulletin, revised monthly.

There's a Reason!

We are not selling all these truckloads of ham equipment just because fellows like to brag that they bought their gear from some dealer in South Dakota, though this is a distinction of sorts, we suppose. We suspect that they are buying from us because we are so removed from the usual ham markets that we don't know what price to charge for our reconditioned gear and we let things go at too low a price. Notice these too low prices and send check immediately.

	Special Cash Price
Harvey Wells T90 xmtr 6V supply	79.00
Heath HG 10 VFO	25.00
Heath HD 10 Q-mult	9.00
Heath DX 20 xmtr	29.00
Heath Apache xmtr	179.00
James C-1050 6/12 dc supply	9.00
Johnson 6N2 xmtr w/VFO, PS & mod.	179.00
Johnson Viking I xmtr	89.00
Johnson Viking I xmtr as is	49.00
Johnson 122 VFO	19.00
Johnson 114-520 Bug	10.00
Knight VFO	19.00
Morrow Mobile Twins & xstr sup	139.00
Mosley CM-1 Rec	119.00
National SW54 Rec	24.00
National NC 109 Rec	89.00
National NC 188 Rec	79.00
National NC 300 Rec	159.00
National 6 & 2 conv in cab	59.00
P&H LA 400C Linear	169.00
Regency ATC-1 Conv	39.00
RME 0B23 Preselector	29.00
RME 6900 Rec w/spkr	189.00
Seco xsistrized S-meter	5.00
Swan SW 120	149.00
Swan SW 120 NEW	169.00
Swan SW 140 NEW	169.00
Swan SW 175 w/Topaz dc sup	239.00
Tecraft TR 20-50 6M xmtr	29.00
Central Electronics 100V xmtr	395.00
Collins 30L 1 Linear	395.00

	Special Cash Price
Collins 75A1 Rec w/spkr	189.00
Collins 75A4 Rec w/spkr	395.00
Clegg 99'er 6M xcvr	*109.00*
Drake 2A Rec w/spkr	179.00
Elmac AF67 xmtr	69.00
Elmac PSA500 ac supply	15.00
Globe Scout 65A xmtr	35.00
Globe 755 VFO	19.00
Globe 755A VFO	24.00
Gonset G66B Rec w/12v supply	99.00
Gonset GSB101 Linear	199.00
Gonset GR211 Rec	39.00
Gonset Commander xmtr w/VFO	39.00
Hallicrafters HT32 xmtr	349.00
Hallicrafters HT37 xmtr	329.00
Hallicrafters S380 Rec	24.00
Hallicrafters S53A Rec	39.00
Hallicrafters S85 Rec	69.00
Hallicrafters SX99 Rec	79.00
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Hallicrafters SX100 Rec	149.00
Hallicrafters SX101 Mk III A Rec w/spkr	199.00
Hallicrafters S 108 Rec	99.00
Hallicrafters S 119 Rec	29.00
Hammarlund HQ 110 Rec	139.00
Hammarlund HQ 110C Rec	149.00

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PHONE
Area Code 605
TU 6-5749

Product Detector

Jim Kyle K5JKX
1236 N.E. 44th
Oklahoma City 11, Okla.

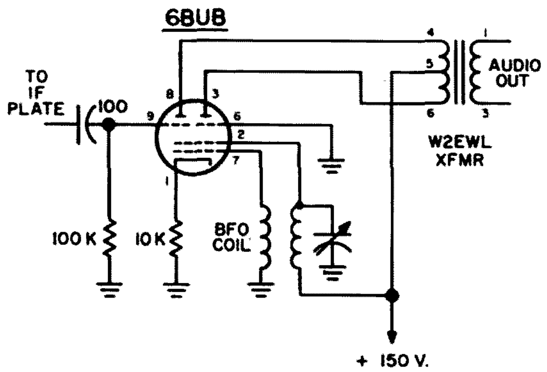
By now almost everybody should be aware that a product detector of some sort is essential for best copy of either CW or sideband signals, to eliminate (or at least reduce drastically) detector distortion and to allow strong signals as well as weak ones to be received.

A host of product-detector circuits are in print; some time ago, we summarized most of them in these pages—and few new ones have appeared since.

At that time, we came to the conclusion that the sheet-beam type of detector had much to offer. Its major disadvantages were the requirement for a special tube (type 7360) and the need for push-pull input for either the *if* signal or the bfo.

But we kept playing with it at odd moments, and took some hints from here and there. The result—a somewhat unusual product-detector circuit which uses only one tube (a TV-replacement variety at that), has high-impedance single-ended input for the *if* signal, and contains its own bfo. Audio output as well is single-ended, and the bfo signal does *not* appear in the output.

The circuit (see schematic diagram) is a blend of standard sheet-beam configuration with a 6BU8 "split pentode" substituted for the true sheet-beam tube, and the "long-tailed pair" phase inverter from the hi-fi realm.



Note the 10K cathode resistor which must not be bypassed. This provides the phase inversion which allows the circuit to act in sheet-beam fashion. At first we were a bit dubious about this, but none of our fears proved justified in practice.

For those of you who may be curious about the 6BU8, it is just a normal pentode except for one thing: it has a pair of suppressor grids and a pair of plates, sharing a common screen, control grid, and cathode. This tube is used quite widely in certain keyed-agc TV circuits, and as a result is more easily obtained in many localities than the special 7360.

Here's how the circuit works. The common screen and control grid are used as plate and grid, respectively, of the bfo. While a tuned-plate feedback oscillator is shown, several other types should work as well. This part of the circuit is almost identical to the conventional electron-coupled oscillator used in VFO's, and modulates the current of both plates by the same principle.

In the absence of *if* input signal, the bfo signal reaches both plates in equal amount and cancels itself out in the push-pull transformer.

One suppressor grid is grounded and the other receives the *if* signal through a coupling capacitor and return resistor. As the *if* signal comes in, it changes the plate current of the upper half of the tube and this in turn changes the voltage drop across the cathode resistor. This change in cathode voltage is an effective change in suppressor voltage in the lower half, and push-pull action at the plates is thus obtained.

Since the bfo is driving the tube to cutoff and saturation on each cycle, it is a non-linear device and the proper mixing or demodulating action is achieved. Since the *if* signal is effec-

tively in push-pull, the demodulated audio is also push-pull and so appears in the transformer secondary.

With normal *if* signal levels, audio output of the circuit shown (using the tiny "W2EWL" transformer) is approximately 10 db greater than the output of a simple diode detector.

The circuit appears to offer excellent isolation of bfo voltage from the *if* strip. In an experimental receiver, with avc active on either AM or SSB modes, the avc voltage did not vary any measurable amount with the product detector switched on or off.

It is essential to keep the screen voltage somewhere close to 150 in this circuit. At lower voltages, the oscillator won't produce enough output to handle strong input signals, while at higher voltages the tube shows a tendency to "lock up." Regulation is not necessary, though, except to assure bfo stability if this is a problem for you.

Distortion is not audible with the strongest input signals. For sheer simplicity combined with excellent performance, we feel this circuit will be hard to beat. . . . K5JKX

Improved Coaxial Fitting Installation

For those of us who are fortunate enough to be employed in the electronics field, the free sample road has another new path to follow. A 12 inch free sample of the new shrinkable plastic sleeving is something any of the vendors of the product will be glad to donate.

This foot of tubing, worth only a few cents, can be used to make a coaxial fitting installation without a peer. Cut it into four inch lengths, slide it over your coaxial fittings which will be required to brave the elements, heat it with a hair dryer, or even carefully with a blowtorch, and it will shrink up neatly around the fitting and the cable, resulting in a fitting which will not take on water in the worst weather, and which is almost impossible to pull apart. If you coat the cable outside the fitting area with Pliobond (or another rubber-type cement) before you seal it, it is almost indestructible. Summers' rain and winters' ice can't get in, and can't pull apart coaxial fittings done this way.

Ham distributors may soon have this as an over the counter item, making this trick available to all. . . . W8BPY

Economical Mobile Transceiver Construction

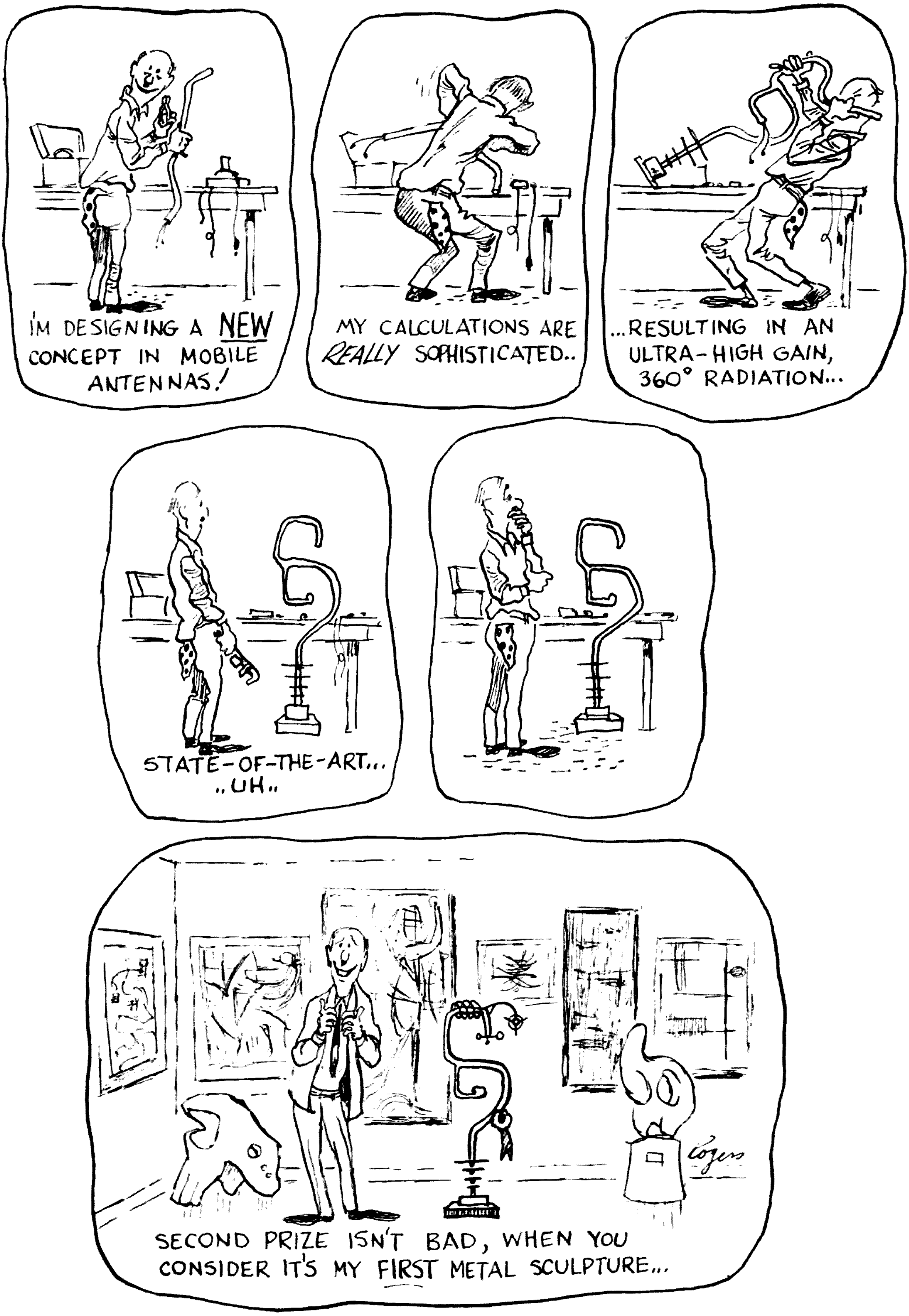
Michael Watson K5MWH
150 Cabaniss
Baytown, Texas

Many of us, from time to time, feel the urge to build our own equipment. However, when the cost of such a building project is considered we are all inclined to forget the whole thing and go call CQ 75. Be not dismayed! Things are not as bad as they may first appear.

Recently a group of local amateurs decided that the time to change to sideband mobile operation had come. After studying several schematics, one was chosen that appeared to suit our needs. Layouts and parts lists were decided upon and the rush for parts was on.

Naturally no self respecting cheapskate would buy all the necessary parts for a project of this size; therefore another source had to be found. It was decided that, if chosen with care, used parts would be suitable. What! Used parts? Those of you not now turning to the next article can start thinking about those precious dollars you may be about to save.

Many of you are familiar with the bargains available in used or discarded TV receivers. Here my friends is the source of numerous usable items, which if bought new, would cost quite a sum of money. One of the most useful items to be found in these TV receivers is of course the tubes. Most TV receivers contain a wide assortment of tubes that can be put to use in amateur equipment. Tubes such as the 6BA6, 6AU6 and 6CB6 are found in the audio and video *if* stages of almost every TV set now available and are useful in receiver rf and if stages. 6AQ5 and 6V6 tubes found in TV audio output stages can be used for the same purpose in home built equipment. The horizontal oscillator, sync, AGC and vertical oscillator sections of the TV set may contain tubes of the 6U8, 6EA8, 12AU7 and 12AX7 types which can be used as audio amplifiers, product detectors, carrier oscillators and speech amplifiers. Let us now take a look at the video amplifier section of the TV receiver. Here are found such goodies as the 6CL6, 12BY7 and 6AG7 which are all excellent for use in driver stages of the exciter


I'M DESIGNING A NEW CONCEPT IN MOBILE ANTENNAS!
MY CALCULATIONS ARE REALLY SOPHISTICATED..
...RESULTING IN AN ULTRA-HIGH GAIN, 360° RADIATION...
STATE-OF-THE-ART... ..UH..
SECOND PRIZE ISN'T BAD, WHEN YOU CONSIDER IT'S MY FIRST METAL SCULPTURE...
Rogers

portion of the transceiver and in the tuner of our new found gold mine 6U8 and 6X8 tubes may be found. In addition to those uses mentioned earlier for the 6U8, these tubes are also suitable in oscillator-mixer combinations. The last source of tubes in the set is the horizontal output stage, where you may find a: 6DQ6; 6BQ6; 6CD6; or even a 6BG6 tube, any of which may be used as power amplifier tubes in the transmitter section of the transceiver. A word of caution should be noted here; the horizontal sweep tubes mentioned for use as final or power amplifiers, all have high inter-electrode capacitances. Many of them are subject to self oscillation in HF stages and caution should be exercised when they are used. Unless the builder has had experience with these *wild* tubes, he might be wise to stay with the old reliables such as the 6146. With a last glance at the top side, don't forget to pluck the rectifier tube (usually a 5U4).

Looking under the chassis, the builder with the trained eye will immediately see the wealth of usable parts hiding there. Most noticeable on the underside of the chassis is the maze of resistors with values ranging from a few ohms to a few hundred thousand ohms in abundance. Those resistors with long leads need only be clipped from their position and they will be ready for use, but those that have short leads should be un-soldered. Very rarely will one find any of these resistors to be bad, and a quick check with a VTVM will assure the builder that the resistors are good. The next useful items to be removed are the small capacitors, the values of which can be easily determined from the color coding printed

on each one. The same precautions should be exercised in removing these capacitors and all small parts as was noted in removing the resistors. The large tubular capacitors in these TV receivers may also appear to be useful, and many of them are; however, caution should be observed when selecting this type of capacitor for reuse: those that are made of plastic or ceramic are good and should work very well; but any wax impregnated, paper capacitor should be discarded as they are subject to leakage and shortage. Always check tubular capacitors for shortage with a VTVM before it is used.

Now comes the main course in our meal of salvaged parts for hiding in each of those *if* transformer cans are the most useful parts to be taken from the TV chassis. Each transformer is wound on a one quarter or three eighths inch coil form. All of these coil forms can be stripped and rewound for use in any tuned circuit and then be put back into the aluminum cans where they will be shielded from stray fields. By now the chassis should be nearly clean. The tube sockets should be cleaned with a soldering iron and removed from the chassis.

If you remember in the first part of this article I mentioned the use of the audio output tube. Very close to this tube a three to five watt audio output transformer will usually be found. A quick check with an ohm meter will tell us if the windings are good and they usually are. The transformers work as well as new ones but don't forget to keep those leads as long as possible.

If the TV receiver is of the type that uses a focus coil, you will find this coil will contain hundreds of feet of wire useful on those coil forms that were removed earlier. The focus coil is a round, flat object that fits on the neck of the picture tube and has a metal case around it. Inside the metal case the wire is usually wound on a plastic spool which will serve for storage. While on the subject of wire, let me remind you that there are many feet of hook-up wire in long and short lengths that can be removed and put to good use. Hook-up wire is cheap until one starts buying it for a large project.

On the front and rear of the chassis are numerous potentiometers which range from low values of a few hundred ohms to the megohm range. All of these controls can be checked with a VTVM and marked with a grease pencil.

Finally, if the receiver is of the power transformer type, remove the transformer, again being careful to keep all leads as long as

possible. Power transformers of this type usually have a five volt winding and two or three six volt windings in addition to the high voltage secondary. Most of the filament windings will deliver from the three to five amps and the high voltage secondary will give around 280 volts at 200 to 300 ma under load. Also near the power transformer should be found a small filter choke whose value will usually range from two to five henrys and will handle approximately 200 to 300 ma.

The chassis should now be free of most usable parts. Make a final check to see that nothing of value has been overlooked. All of the salvaged parts should be put into boxes where they will be ready for use. As mentioned before, the search for an economical source of parts was prompted by our desire for several mobile SSB transceivers. Presently, two of the rigs have been completed and are in use and three more should be ready soon. All of these units have used parts in them and no difficulties have been encountered as a result of the used parts. Of course, one does not rely completely on used parts, parts for critical stages such as VFO's should always be new and of highest quality.

Many TV shops throw away old sets that can not be fixed for resale. By keeping a sharp eye out, the builder may locate a number of sources of discarded TV sets. Finally let me issue to one and all a word of caution: if possible, TV sets without picture tubes should be obtained. *TV picture tubes are very dangerous!* If they are dropped or receive a hard blow, they may implode sending thousands of small pieces of glass in all directions. These pieces of glass travel with great speed and can be *flying death*. Be careful, good hunting, and I hope to hear that new transceiver soon.

. . . K5MWH

Institute Museum

If you have any ham gear circa the mid or early thirties please make arrangements so it won't be junked when you leave us. We'd sure like to have it for display in the museum here with your QSL on it.

Europe!

Tally Ho

The big trip to Europe will be leaving Idlewild October 6th at 10 PM. We'll all be gathering in the BOAC departure rooms at about 8 PM and checking it. Sorry if you didn't take us up on this one, we're going to have a lot of fun. We'll be back the 28th. If you want to drop any notes to the group we'll be picking up our mail at the American Express offices at each city on the route. Drop mail to Wayne Green, c/o American Express, London, Paris, Geneva, Rome, and Berlin. London the 10th, Paris the 15th, Geneva the 18th, Rome the 23rd, Berlin the 25th. Allow plenty of time for the mail, I'll pick it up on the specified days.

It would surprise me no little and quite some if we didn't have a fairly good article on the trip by and by to help those of you who procrastinated on this one to eat your hearts out.

Tour Cancellation

One couple that had planned to go on the tour suffered a last minute sickness which forced them to cancel. This means that we have two spots open if any of you would like to make a last minute decision to go along. We leave from Idlewild October 6th and return the 28th, total cost of trip for all air flight, bus travel to and from airports in Europe and hotels with breakfast is $550 each, which is considerably less than the $630 round trip economy fare to Rome. We'll visit four days each in London, Paris, Geneva, Rome, and Berlin. Call if you would like to climb aboard.

A Novel Type High Capacitance VFO

Tima Popovich ex-YU1FR
Banat, Novo Selo
Yugoslavia

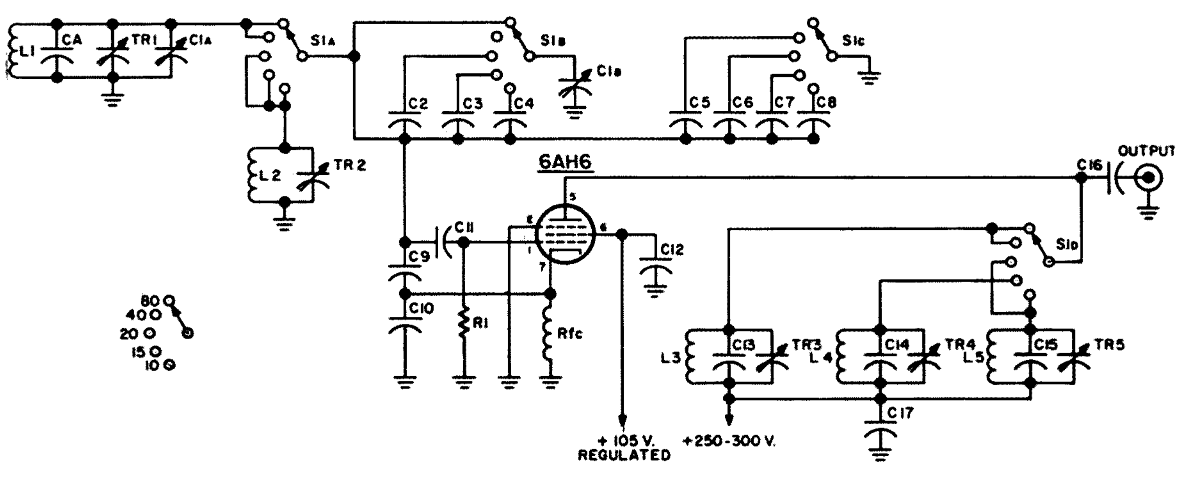
The March 1962 issue of the "DL-QTC", the official publication or DARC, brings the description of a novel type high stability vfo with high capacitances, developed by G.G. Nierbauer DJ2XP which we are presenting in the following article in a new form, adapted to American standards.

The unit includes a number of remarkable features that make it quite attractive to the amateur builder. It's simple to construct and requires parts that are handy in the junk box of almost every radio amateur. A one knob bandswitching array assures coverage of the 80 through 10 meter amateur bands, while a large directly calibrated dial provides full band spread on all frequencies. The output frequency of the vfo is the same as that of the final amplifier of the transmitter on the 80, 20 and 15 meter bands, but doubling is required for operation on the 40 and 10 meters. This means that such a vfo can be successfully used in practically any compact two stage transmitter.

In spite of all its simplicity in construction and operation, the stability and efficiency of the unit are exceptionally advanced.

A reference to the schematic diagram will show that the two series capacitors C9 and C10, unusually high in value compared to the tube internal capacitances they are shunting, are connected in the same manner on all bands to avoid tube effects on the grid tank circuit, thus providing a good stability. On the other hand, the parallel tuned grid tank circuit assures a constant power output over a broad frequency range, which is not the case with the well known Clapp circuit, for example, resulting in a smooth excitation of the following stage, which in turn makes for better efficiency.

The oscillator tube, for which a 6AH6 is most convenient, doubles or triples in the plate circuit the frequency generated in the grid circuit on certain bands, as explained in Table 1, which shows grid and plate frequencies with their respective active elements for each particuar band.



New Products

Super-Q

A new manufacturer has entered the beam antenna field with a six and ten meter beam. The six meter beam has six elements on a 15 foot boom which is slightly arched to compensate for the sag one would normally expect in an antenna of this length. There is some weight to be reckoned with too, for the elements are all one inch aluminum which should result not only in a very sturdy and long lived beam, but should give a wider bandwidth than beams with smaller diameter elements. Plastic caps are provided for all elements. Claimed gain is 11.2 db over a dipole with a front to back ratio of 25 db. Beam width 42°. Match is a trombone gamma type and is factory adjusted to match RG-8/U. It can be tuned for variations in coax impedance or beam impedance due to height above ground. Price is only $27.95. Super-Q Products, 3363 Verner Road, Kent, Ohio. Their three element ten meter beam is $29.95 and is equally solidly built. Send for info to the manufacturer and watch for their ads.

VHF Gear

Amplidyne Labs has announced three additions to their line of VHF equipment. The model 126 three band converter (left) covers 50-144-220 mc, has built in power supply, nuvistor front end, grounded grid, four i-f outputs to meet your needs. $94.50. The model 621 transmitter (center) covers both six and two meters, 8150 final running 60 watts. Xtal controlled or external VFO. Built in dummy load, grid bias supply for final protection, all stages metered, including rf output, AM or CW operation, PTT. $229.50. Model 221 220 mc adapter puts you on 220 mc with 18 watts AM or CW when driven by #621. Uses 621 power supply, modulator and metering circuits. 6360 final. $72.50. This means that you can operate on all three VHF bands with complete converter and transmitter for a combined price under $400! Amplidyne Labs, Box 673, Kings Park, L.I., N.Y.

Letters

Wayne,
W3AQT's decision, "I will not spend any more money for your magazine," struck me as being an interesting attitude. Since October 1960 I've been buying several copies of each issue in addition to my subscription copy: one copy, the one with no wrinkles, goes into the historical file. The others are handled and passed around. The competition? One copy per each.

Ted Shaw W6AVN

Dear Wayne,
". . . how come you are making obeisance to CQ and K6BX by including Greene County on your QSL? Is this an olive branch being extended?"

K5BBA

I understand that they have decided not to count Greene County New Hampshire toward the CQ awards. I think that is pretty small, don't you?

Should the vfo be connected to the following stage by means of piece of 52 ohm coaxial line not exceeding 2 inches in length, the correct value for the C16 capacitance is around 200 mmfd. With a longer line (2-6 inches), a 100 mmfd capacitor is more profitable.

Alignment

An accurately calibrated receiver or a good grid-dip meter will do as an adjusting instrument.

80 m Set C1 to maximum capacity, tune TR1 to 3,510 kc; then turn C1 to minimum capacity. The oscillating frequency should now be brought to 3,750 kc.

40 m TR1 remains untouched, while C1 should be set to maximum capacity. Should the oscillator frequency lie under 7 mc, the capacitance C5 has to be changed to 430 mmfd. Should, on the contrary, the oscillator frequency be higher than 7 mc, the value of C5 should be increased to 470 mmfd. Now turn C1 to minimum capacity and bring the oscillator frequency to 7.3 mc. The operation should be repeated several times, readjusting again and again the active elements, until the tuning range of the vfo settles between 7 and 7.3 mc.

20 m Turn C1 to maximum capacity and adjust the oscillator frequency with TR2 to 14,010 kc. Then set C1 to minimum. Should the oscillating frequency be higher than 14,350 kc, the value of C2 has to be changed to 100 mmfd. Now turn C1 to maximum again and readjust the frequency with TR2 to 14,010 kc.

15 m TR2 remains untouched: C1 is set to maximum. Should the oscillator frequency lie under 21 mc, C7 has to be increased to 330 mmfd. Now turn C1 to minimum. Should the oscillator frequency be higher than 21,450 mc, the value of C3 is to be changed to 90 mmfd. Then turn C1 again to maximum and readjust the oscillator to 21.0 mc.

10 m TR2 remains still unchanged. C1 set to maximum capacity. Should the oscillator frequency lie under 28 mc, C8 should be decreased to 240 or 230 mmfd. Now turn C1 to minimum. Should the oscillator frequency be higher than 29.7 mc, the value of C4 should be decreased to 450 mmfd.

C1 is now to be set again to maximum and the oscillator adjusted to 28.0 mc. Should the frequency lie under 28.0 mc, C8 has to be decreased to 220 mmfd.

It is quite desirable to connect an air trimmer across each of the capacitances, from C2 to C8, in order to facilitate finding out the correct C values for each particular band, without being obliged to solder in and out an excessive number of small capacitances.

The plate circuit is to be adjusted as follows:
80 m: Bring TR3 to maximum output at 3.65 mc.
40 m: TR3 unchanged.
20 m: Bring TR5 to maximum output at 14.3 mc.
15 m: Bring TR4 to maximum output at 21.25 mc.
10 m: TR5 unchanged.

Power requirements are quite small: 6.3 volts at 500 ma for the filament and 150 to 250 volts at 15 ma for the plate. Stabilization is needed for the screen grid voltage.

. . . YU1FR

Transmitter output	Grid circuit Tuning range	Grid circuit Active elements	Plate circuit Oscillator output	Plate circuit Active elements
3.5 to 3.8 mc	1.75 to 1.90 mc	CA, C1A, C1B, C9, C10, TR1, L1	3.5 to 3.8 mc	C13, TR3, L3
7.0 to 7.2 mc	1.75 to 1.80 mc	CA, C1A, C5, C9 C10, TR1, L1	3.5 to 3.6 mc	C13, TR3, L3
14.0 to 14.4 mc	7.0 to 7.2 mc	C1B, C2, C6, C9, C10, TR2, L2	14.0 to 14.4 mc	C15, TR5, L5
21.0 to 21.45 mc	7.0 to 7.15 mc	C1B, C2, C7, C9, C10, TR2, L2	21.0 to 21.45 mc	C14, TR4, L4
28.0 to 29.8 mc	7.0 to 7.45 mc	C1B, C4, C8, C9, C10, TR2, L2	14.0 to 14.9 mc	C15, TR5, L5

Table 1

Parts List

C1A, C1B-15-	450 mmfd (conventional two gang variable)
C2	120 mmfd ceramic
C3	100 mmfd ceramic
C4	500 mmfd ceramic
C5	450 mmfd ceramic
C6	300 mmfd ceramic
C7	320 mmfd ceramic
C8	250 mmfd ceramic
C9	2000 mmfd mica
C10	2000 mmfd mica
C11	200 mmfd ceramic
C12	2000 mmfd ceramic
C13	30 mmfd ceramic
C15	20 mmfd ceramic
C16	see text
C17	2000 mmfd paper
CA	2000 mmfd ceramic or mica
TR1 to TR5	50 mmfd air trimmers
R1	50 K 1 w
S1A to D	4 pole, 5 position ceramic switch

Reference

G. G. Nierbauer, DJ2XP, "VFO mit hohen Kapazitaten," Das DL-QTC, March, 1962, page 114.

Coil Data

L1-3 μh—	17 turns #18 (B&S) wire, ½" diameter ceramic form, one inch winding length.

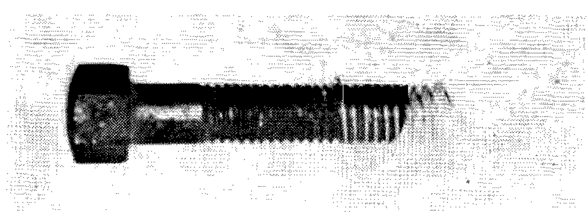
coil data, continued

L2-0.4 μh—	4 turns #16 (B&S) wire, ½" diameter ceramic form, 11/16" winding length.
L3-30 to 70 μh—	about 30 to 40 turns #24 to #32 (B&S) wire, ⅝" diameter ceramic form, close wound.
L4-1 to 2 μh—	12 turns #24 (B&S) wire, ⅜" diameter ceramic form, ⅜" winding length.
L5-1.5 to 3 μh—	18 turns #24 (B&S) wire, ⅜" diameter ceramic form, close wound.
RFC-1 mh—	RF choke.

Coil Winding Hint

Kent Mitchell W3WTO
1760 Preston Road
Hagerstown, Maryland

An effortless method of winding small coils of precisely the desired number of turns per inch and correct spacing is as easy to come by as selecting the proper machine screw or bolt



from your junkbox. After consulting the chart below, wind the wire on the screw or bolt threads for as many turns desired. Then to remove the coil, simply unscrew the screw or bolt from the wire . . . and you will have a neat and accurate inductance.

Diameter	Threads Per Inch Coarse	Fine
1/4 inch	20	28
5/16 "	18	24
3/8 "	16	24
7/16 "	14	20
1/2 "	13	20
9/16 "	12	18
5/8 "	11	18
3/4 "	10	16
7/8 "	9	14
1 "	8	14
1 1/8 "	7	12
1 1/4 "	7	12
1 1/2 "	6	12

. . . W3WTO

73 test the

Clegg Thor

Wayne Green W2NSD/1

As mentioned in the editorial last month, the Clegg Thor was given a good stiff workout at our new VHF HQ station during the June VHF ARRL QSO Party. Frankly, it was a spectacular improvement over anything we've ever used before.

The Thor is a six meter transceiver that provides full VFO operation on the received frequency over its entire range of 50-52 mc. This is all that is needed for practical operating purposes, with nothing much inhabiting the higher regions of the band except wide band FM nets which wouldn't be contacting a Thor anyway. Even under the most crowded band-open conditions you seldom hear more than a few stations venturing above 51 mc and those seem to be on popular surplus crystal frequencies only.

The Thor's ability to transmit on the received frequency (and vice versa) is helping to make six meters a lot more like the lower frequencies in operation where more and more stations are VFO controlled and stick to each others frequency. This type of operation is invaluable in contest work and during band openings. As more and more stations tune their own frequencies first I think we will find more and more demand for VFO's.

During this last contest I found I was able to run rings around some of the rock-bound stations. One, parked on top of a nearby mountain with his kilowatt and big beam, was very frustrated because he would call CQ (rock-bound) and the station answering him would come back on his frequency. This was OK until he signed and then I came in loud and clear on the channel calling the station he had just worked. Though the Thor is no kilowatt, its 40 or so watts output raise hob on a frequency for a hundred miles or so and he had to give up and change crystals to keep working. He found this out the hard way by trying over and over to drown me out. I don't drown.

The Thor has a crystal socket on the front panel and can be simply switched to crystal operation of the transmitter. This is very handy for calling CQ or working stations that are outside of the band without having to tune the dial back and forth as you transmit and receive. I got out the old rack of six meter crystals and kept them handy so I could flip them in as desired. By having four or five crystals you can have one fixed spot in each one hundred kilocycles and you have no problems.

The Thor is also engineered for CW work. I haven't found much of this going on yet, but should it develop I'll be ready. I was sort of surprised not to find any CW during the Field Day contest for six meter CW contacts could easily have run up the score quite a bit for many stations. I called CQ many times on the low end, but never got an answer even though dozens of stations had worked all comers and were wasting their time calling CQ Field Day over and over on phone.

It is a pleasure to find a commercial transceiver that includes a bfo for CW reception. The bfo on the Thor is a combination spotting switch and bfo. There are three levels of injection so you can match the incoming signal for good copy. It even works on SSB, although you have to tune a little bit when you turn it back to an SSB station. I have worked most of the six meter SSB'ers now, so I can vouch that the Thor can do it.

One big problem on six meters is overload and cross-talk from nearby stations. Even the loudest of the competing stations in the VHF contest did not cause any cross-talk in the Thor. The nearby kilowatt did take out about 100 kc, but most fellows were complaining that he spread over 400 kc or worse, so the Thor did a fine job.

The Thor comes with an ac supply, or you can get it with a dc supply for a real potent mobile unit. It has push to talk operation or can be operated from the front panel. It has a noise limiter for hushing ignition noises. It has an effective S-meter that you don't have to apologize for every time you give a report.

As with all other Clegg gear, it is obvious when you use the Thor that they tried to give the most they possibly could, with price being secondary. Even so the price is amazingly reasonable: $349.95. . . . W2NSD/1

Transistor Mounting Techique

Many methods are used for mounting transistors and terminating the leads at the desired circuit points. These range from the use of conventional sockets or special mounting clips through the expedient of tacking in the full length leads and letting the transistor flop in the breeze.

A particularly simple and effective mounting method for round body transistors is shown in the photograph. This is a W4WKM variation of a method used in equipment manufactured by R.M.S. Associates of Mamaroneck, N. Y.[1] This method is equally suitable for use with printed circuit boards, terminal boards with eyelets or turret terminals and perforated board with push-in terminals.

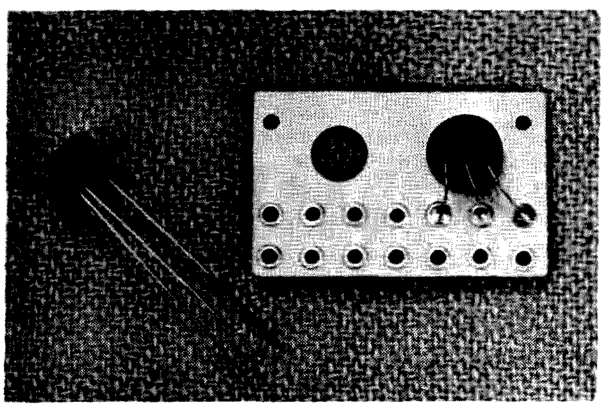


Photo by: Morgan S. Gassman, Jr.

The photograph shows the method. Simply drill a hole in the printed circuit or terminal board slightly smaller than the body of the transistor. Using a tapered reamer from both sides of the board, very carefully enlarge the hole so that the body of the transistor makes a snug force-fit in the hole. Dress the leads to the circuit termination points and solder in place.

The result is a neat, secure and space-saving mounting that is ideally suited to experimental and amateur construction projects. Try it on your next project.

. . . W4WKM

[1] "Press Fit Simplifies Transistor Mounting," Electrical Design News; May, 1962.

Harvey Rock WA2BWQ
1865—77 Street
Brooklyn 14, New York

Radio Astronomy

Part I

Radio astronomy was born in the year 1932, when Karl Jansky, a new member of the Bell Telephone Laboratories staff was sent to an experimental radio station at Holmdel, New Jersey. His job was to track down "atmospherics" which caused hums, whistles, and rumbles in radio receivers.

Jansky made a big antenna, 100 feet across, which he could rotate like a merry-go-round and so point in any direction he desired. Using this antenna he ascertained where each noise was coming from, identifying and studying the effects of thunderstorms on radio.

One thing had him puzzled, a weak hiss in his earphones, so weak that he could hardly hear it above the hum produced by his receiver itself. Jansky found that the noise appeared to rise with the sun in the morning and follow it. At first he thought it was caused by the sun itself, but as the months went by the source of this noise went more and more out of step with the sun, until he could hear it in the middle of the night. He studied his carefully kept records and found that the noise began four minutes earlier each day. He knew nothing about astronomy, so he referred to textbooks and decided that the signals were coming from the Dumbell Nebula in Cygnus.

The news of Jansky's discovery swept round the world. It made headlines in many of the newspapers, and the signals from the sky were relayed to New York and broadcast for everyone to hear. However, as suddenly as it had come, radio astronomy was forgotten.

Jansky pleaded with his employers to allow him to carry on his studies, but the needs of radio-telephone communication came first, and after a few years of experimenting in his spare time, Jansky gave up.

The radio engineers were not interested because they were too busy and knew nothing about astronomy; the astronomers, too, were busy and knew nothing about radio.

Only one man, Grote Reber, continued the study which Jansky had begun. Reber built a big thirty foot dish in his back yard. With it he studied the sky and confirmed what Jansky had discovered.

Part II

A radio telescope is really just a glorified radio receiver. However, the first thing which makes a radio telescope different is the size and shape of its antenna. It is true that you can pick up "radio signals from the sky" with almost any antenna, but most radio telescopes have more sophisticated antenna systems. The major reason is as follows:

If there are two radio stars close together a large radio telescope can separate one from the other, but a small antenna will simply record them as one large object. The ability to separate two stars close together is called *resolution*. (The human eye has an aperture of about ¼ inch, or about 6,000 wave lengths of light. A radio telescope "listening" at a wave length of one meter would need an antenna four miles wide to get the same resolution. To get the same resolution as the 200-inch telescope of Mount Palomar, the radio telescope's dish would have to be about the size of the Earth.)

Many radio telescopes use a big parabolic dish which collects the signals and focuses them on an antenna at the focus of the dish. All signals coming from the direction in which the dish is facing reflect properly on its focus. Signals from different directions are also reflected but miss the focus and are not picked up by the antenna. Thus the radio telescope can pick out one part of the sky.

The largest steerable radio telescope is the

TOLL-JA. For several months we've been threatening an increase in subscription rates. Though we've made publishing history with our low overhead we still haven't found out how to mail heavier magazines without paying the post office more. We must pass this little problem along if we are to print larger magazines. Subscriptions innocently sent in at the old rate will be prorated to 10 months. The club rates are now $3.50 in groups of five or more. Foreign subscriptions are the same rate as everyone else.

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Start with ____ | 73 Products: (page 91) ____

Back issues (page 91) ____

Badge. Red ____, Black ____. (page 91) First name: ____ Call ____ $1.

250 foot Jodrell Bank telescope. To give its full title, it is the Steerable Paraboloid Altazimith Radio Reflector. What the British astronomers wanted when they designed the Jodrell Bank dish was a large reflecting dish which could be pointed anywhere in the sky, with a mast sticking out from the middle to carry the antennas at the focus of the dish. So that they could change antennas quickly, the whole dish must be turned upside down. The 800 ton Jodrell Bank telescope has to keep its parabolic shade accurately in whatever direction it is pointed.

The dish and its supports, weighing 1,800 tons together, turn bodily on a circular railway track. At full speed it can turn one complete revolution in 18 minutes, and the dish can transcribe a complete vertical turn in 15 minutes. It performs its scientific "twist" with the utmost gentleness and precision under the control of robots which can, for example, keep it trained on a star as it moves slowly across the sky.

Not all radio telescopes are steerable. Alongside the "Great Ear of Jodrell" there is a 220 foot dish made up of wires, lying on its back facing the sky with an antenna mast sticking up in the center. This telescope can watch only that part of the sky which moves directly over the dish.

The "Great Ear of Jodrell" is not the biggest radio telescope in the world, though it is at the moment the biggest steerable one. There are far bigger telescopes which work in a different way. These are called radio *interferometers*. The biggest, at Cambridge, are used to chart the most distant radio stars.

A radio interferometer consists of a number of antennas spaced widely apart. The easiest way to understand how a radio interferometer works is to think of the antennas as bits of one large antenna. Such a huge, imaginary antenna would make a very good and accurate radio telescope, but you can pinpoint radio stars as accurately with only bits, working together.

The radio interferometer is extremely directive. To be in phase with both antennas of the telescope, the star must be at an exact central position above and between the antennas. If it is not, it is out of phase with respect to one of the antennas and is phased out.

You have to pay a price for the advantage of saving so much antenna construction. The "picture" of the radio sky which you get using a radio interferometer is not a straightforward one. Using only parts of an antenna, instead of a picture you get a complicated pattern from which the radio astronomer has to calculate the actual position of radio stars. Also, the strength of the signals collected by these parts of an antenna is less than what it should be if the whole antenna were there.

The new Mullard Radio Observatory at Lord's Bridge near Cambridge has two great interferometers: one for studying the Milky Way; the other for picking out radio stars. Each is a long trough-like antenna (in one case 3200 feet long; the other 1450 feet long), together with a smaller movable antenna. Each collects radio waves over an area of 4½ acres, and they are the biggest radio telescopes of all.

After the antenna, signals are fed into either parametric amplifiers or masers and thence to a very sensitive receiver. A practical radio telescope would have to have a tuneable receiver. This is made necessary by the Doppler effect (as an emitting body moves away, its frequency is lowered; and as it comes closer, its frequency is raised).

The rectified signals are then translated into digital form and fed to computers for analysis and evaluation. This leaves the scientist time to devise more tricks for his mammoth toy to perform.

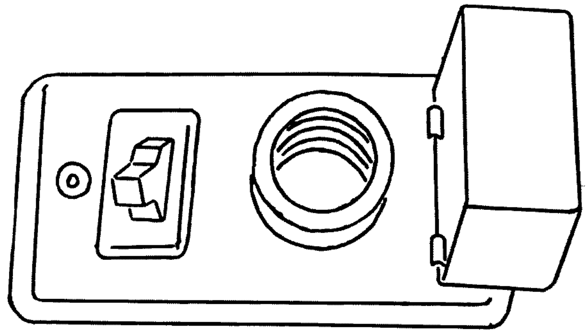
Bigger and better telescopes are planned for the future. Radio astronomy is still in its infancy, but much is hoped for in the future.

. . . WA2BWQ

The Big Switch

How many times have we ended a QSO with, "I've got to pull the big switch?" There is no telling how many switches actually have to be turned off. There is the switch on the transmitter, the switch on the receiver, the switch on the vfo, the switch on the monitor, the switch on the . . . well we could go on with quite a list of pieces of equipment that must be turned off before the station is closed down. The turning off of switches can be time consuming as well as risky. There is always the chance that a switch will be overlooked and left in the "on" position.

What is needed in most shacks is a readily accessible switch that will kill all the power at the operating position when the operator goes



QRT. Like most hams I run low power and so a 15 amp 125 volt circuit suits my needs as it may suit some other operators. As a main switch I use a device known to most electricians as a BUSS Fustat Box Cover Unit.

This switch, made by the Bussmann Mfg. Div., is small, inexpensive and available from most electrical wholesalers and some electronic distributors. Although it was designed to protect small motors from burnout, it suits our purpose as a fusible 15 amp main switch. It is easily adapted to most desk and console set-ups as a flush mounted device and it gives localized branch circuit protection. At my station I mounted the unit at the front of my desk and from there I ran the conductors to several convenience outlets mounted on the rear of the desk. The clock mounted beside the box cover unit is wired in ahead of it. All of the station equipment is plugged into the outlets on the back of the desk creating a neat and orderly arrangement. The box cover unit is fed by conductors from the nearest convenience outlet in the wall. Although the socket in the box cover unit has Edison Base threads for the common plug fuse, an adapter and the non-tamperable type "S" Fustat should be used. The box cover unit I used was the BUSS type SSU which fits the 2¼ inch handy box. They also make a type SSW which fits the 2¾ inch switch box. Both of these units list for $1.20 each. The 15 amp Fustat, S15, lists for $.21 and the adapter, SA15, lists for $.13 so the whole ball of wax is quite inexpensive. Bussmann also makes a 250 volt double pole switch and two fuse holder unit type STY that mounts on a 4 inch square box for the high power boys who use 220 volts.

This flush mounted switch makes a very neat installation and eliminates some of the rat's nest of extension cords and plugs usually found on most operating desks and tables. Most important, it does this economically and the net result is an attractive toggle type disconnect that turns on all of the station's components at the flick of a single switch.

. . . W4STX

Double Power for cw

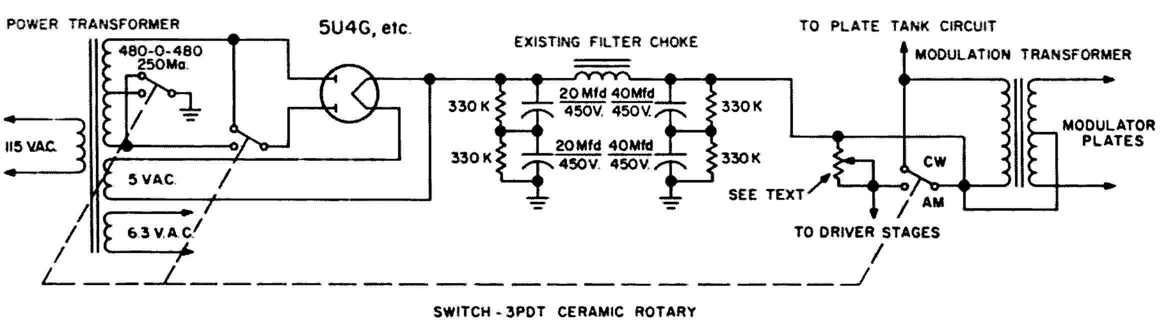
Hank Meyer W2EZJ, K3URS

Recently I designed a small transmitter for a friend using parts from the junk-box. Available were an 807W, 616s, a 20 watt modulation transformer, and components for a 400 volt, 250ma. power supply. I was all set to design the run-of-the-mill 40 watt phone-cw transmitter when it suddenly dawned on me that there was a complete waste of the 807W's cw capabilities. Since the transmitter was for 40 and 20 meters, it was desirable to get the most power out of the available components as possible. The limitations of the modulation transformer dictated that only 40 watts AM could be realized, but I hit upon an idea which would make it possible to run 75-80 watts on cw. The basic circuits are far from revolutionary, but I have never seen a system of this type used. The method of conversion consists of the addition of only a ceramic rotary switch, two extra capacitors, and a few resistors. The circuit can easily be extended to higher power transmitters as well as to such commercial units as the Lettine, Globe Scout, and others too numerous to mention.

Two sections of a triple-pole double-throw switch are used for the voltage conversion. For AM operation the transformer feeds the 5U4G as a full-wave rectifier delivering 400 volts to the 807W and 6L6 plates. For cw operation the 5U4G plates are shorted, one end of the transformer secondary is grounded, and the 5U4G is fed as a half-wave rectifier delivering 800 volts to the 807W plate. The third section of the switch shorts the secondary of the modulation transformer and places a resistor in the circuit to lower the voltage to the driver stages when cw operation is desired. The value of the dropping resistor (R5) will be determined by the current used by the driver stages and the voltage drop required to bring the voltage to the normal operating value. This resistor is external to the normal dropping resistors used in the driver stages. The additional capacitors are added in series with the existing filter capacitors to allow for the raised voltage. Of course, if the existing filter capacitors are of low capicity, they, too, will have to be replaced to give adequate filtering of the half-wave output. The 330,000 ohm resistors are placed in the filter section to assure that the voltage developed across the capacitors is the same for each so that their 450 volt rating will not be exceeded.

No difficulties should be encountered in the operation of the transmitter if a few precautions are taken. The plate by-pass capacitor should be of high enough voltage rating to allow for the increase. The plate tank capacitor should not have to be replaced since it is designed for peak voltages, developed under AM operation, which won't be exceeded under the new cw conditions. Most important of all is that the AC POWER SHOULD BE TURNED OFF BEFORE SWITCHING MODES OF OPERATION.

. . .W2EZJ



Attention Club Secretaries

Many of us, in our affiliations with radio clubs, nets, or MARS find it necessary at times to address mail to certain addresses fairly regularly. A great deal of time that could otherwise be used for operating on the air or for experimenting at the bench is taken by the chore of addressing this mail.

Unless you are an ardent secretary (or have one at your command) you would probably be glad to turn your address-o-graph duties to someone else. But alas! There is an easy way to do the job. This method works on the principle of the "Ditto" machine, or hectograph, but on a smaller scale.

Obtain one or two carbon-backed master sheets (such as Curtis-Young "Sealfast" Master Unit #H 109, Panama Beaver "6X Unimaster", or equivalent). Type your mailing addresses directly on the glossy side of the master sheet. This will cause the special carbon from the backing sheet to stick to the back of the master. (Be sure to remove the protective tissue from between the carbon sheet and the glossy sheet.) An address form of three to four lines can be trimmed to a stencil size of about four inches wide and an inch to an inch and one-half long—so that one stencil sheet will make at least 15 or 20 address stencils. These stencils can all be stored together in an envelope when not in use.

To address the mail, take a ball of absorbent cotton about the size of your thumb, wet it with ordinary rubbing alcohol and wipe over the area where address is to be. Before alcohol dries, place stencil—carbon toward wetted paper—against the envelope and rub thumb across back of stencil, pressing it against the envelope. Lift off the stencil and your mail is addressed. The entire operation of addressing takes no more than ten or fifteen seconds once the stencils are prepared. Each stencil is good for at least 25 or 30 uses. This system is a lot less messy than trying to use mimeo ink and stencils by hand, as some do. The master stencils may be obtained for about 10¢ each at most stationery stores and a good sized bottle of rubbing alcohol may be had for 35¢.

See you on the air in your spare time!

. . . W2BVE

Panadaptor Converter

Larry Kiner K6VNT
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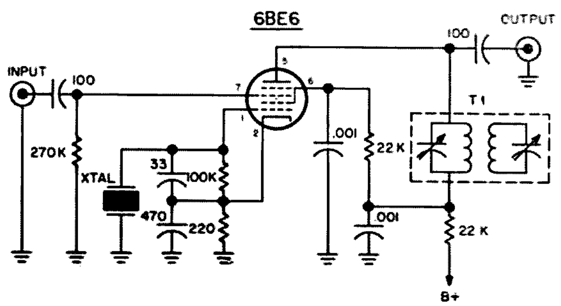
Reseda, Calif.

Have you hesitated buying a panadaptor because your receiver *if* frequency and the panadaptor input frequency are different? Many amateurs have assumed that both frequencies must match or the units will not be compatible.

Here is a circuit that will eliminate your concern in purchasing one of these most sought after devices and give you untold pleasure in watching band activity.

The total purchase price for the converter components should not exceed $10.00. The unit may be built onto either the receiver chassis or the panadaptor chassis, whichever offers the most room. The builder may, of course, build the converter into a small outboard chassis if desired. If installation is to be made on either the receiver or panadaptor, it might be wise to build the circuitry onto one of the popular vector sockets to reduce the total area required for the converter.

Two of the components required in the converter will be determined by the receiver *if* and the panadaptor input frequency. These two are the crystal and the output transformer. To determine the crystal frequency we add the receiver *if* frequency and the panadaptor input frequency together. The author has a NC-300 currently used in conjunction with a surplus Navy Type RCX panadaptor. The first *if* of the NV-300, 2215 k, is used. The input frequency of the RCX is 455 kc. Adding these two together gives us 2670 kc, which is the crystal frequency. This same procedure would be used



for other *if* frequencies.

The transformer is determined by the panadaptor input frequency. Select an inexpensive *if* transformer that will match the panadaptor input frequency. Only the primary is used. After the circuit is completed it may be necessary to peak the primary for maximum gain. This is the only adjustment required in the converter.

Connection to the receiver is made according to the instructions of your panadaptor manual. If you have a surplus panadaptor without a manual, you may want to try this method which has proved most successful at the QTH of K6VNT.

Remove the tube shield over the receiver mixer tube. Wind 10 to 15 turns—the number of turns is not critical—of tinned wire around the tube itself. At the top end of the coil solder the inner conductor of a length of shielded wire (do not use coax as it is too bulky). Now wrap some black electrical insulating tape around the coil and the solder connection. The purpose of this is to preclude the possibility of shorting the coil and solder connection to the grounded tube shield. Replace the tube shield by slipping the shielded cable through the shield. Finally install a connector —coax or phono—at the free end of the shielded cable and plug this into the input plug of the panadaptor converter. The gain obtained from this method should be more than adequate and it introduces absolutely no degradation of receiver performance.

Converter construction is straight forward and not at all critical. The only precaution that should be observed would be in the use of shielded cable for both input and output connections.

(Turn to page 100)

(Panadaptors from page 99)

This circuit is most useful to receivers employing dual or triple conversion and it is recommended that the first *if* frequency be chosen to work with as this will give you the most bandwidth for your panadaptor. The converter has been built locally for receivers having 1650 kc and 2215 kc *if's* and panadaptors with input frequencies of 400, 455 and 500 kc, with everyone a success.

B+ requirements for the panadaptor converter may be drawn from either the panadaptor or receiver and should be approximately 200 volts. The 6BE6 will draw about 10 ma B+ and 300 ma filament, which are readily available from either source.

Best of luck and good viewing on your panadaptor.

. . . K6VNT

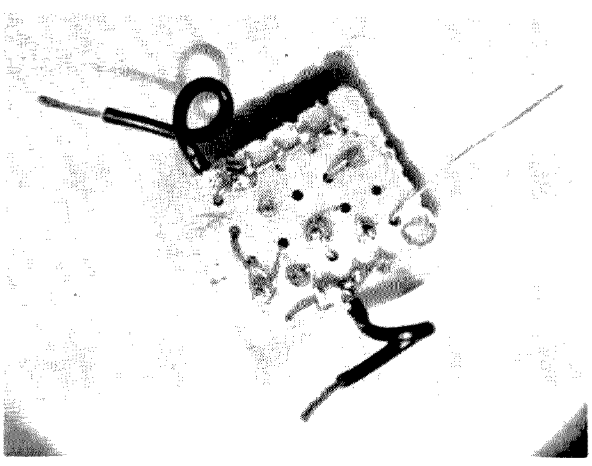
Compact Transistor Circuits

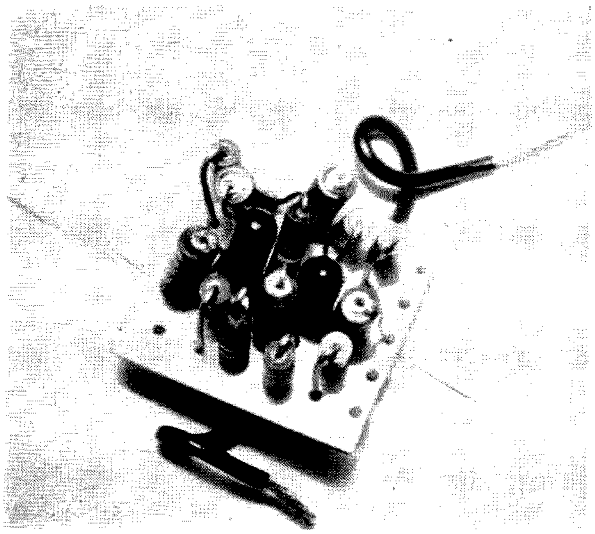
Steven Pullman
10 E. 198th St.
New York 68, New York

I recently became the possessor of a high impedance, low output, dynamic microphone. The output of the microphone is 70db below 1 volt/microbar. Because of this low output, an amplifier was needed to provide a usable voltage level. My main consideration was space.

Printed circuit construction appeared to be the best method, but in order to reap all the benefits of printed circuits, resistors and capacitors must have leads from one end only. Not having the materials to make a printed circuit nor the special lead configurations, I had to find another method of a compact circuit arrangement. What I came up with is a printed circuit technique without the printed circuit or the special components.

I used an unclad, 1¼" x 1" perforated board with closely spaced holes. The circuit is a two transistor preamplifier. The components are standard except for the electrolytics, which are inexpensive miniatures with standard axial



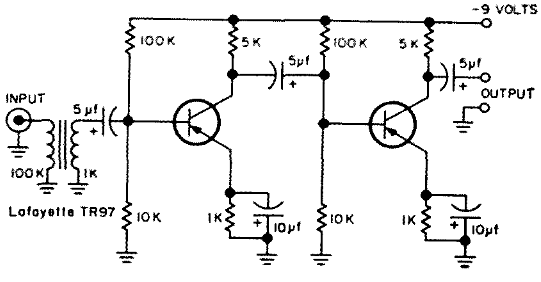


leads. The circuit is laid out on the board exactly the way the schematic is laid out. Components should be bent carefully, and only once, or else extra components will be needed. Check the polarity of the electrolytics before soldering them in the circuit. I learned this the hard way! Use heat sinks on the transistors and use a low wattage soldering iron.

The finished product contains eight (½ watt) resistors, four miniature electrolytics and two non-miniature transistors. Since the pictures were taken, two more standard size capacitors were added to the board. The transformer is a miniature type, a Lafayette TR97, which is not mounted on the board, but in the microphone case.

No feedback problems were encountered because the circuit is laid out in a straight line. This psuedo-printed circuit construction can probably be used up thru the broadcast band. By the way, the amplifier has a voltage gain of 520 with an input voltage of 5 millivolts. The frequency response is very wide, too wide for speech work. It can be restricted to speech frequencies by placing a 0.0033 mfd capacitor in series with the input and a 0.01 mfd capacitor shunted across the output to ground. This will limit the response to approximately 300 cps to 3500 cps.

. . . Pullman



Transistors: 2N280 or 2N190

(NSD trivia from page 4)
hotels most places are remarkably reasonable and I'll bet that we would have little difficulty in holding ourselves to $5.00 per day for hotel and food, which would cost about $300 for a 60 day trip.

I had in mind an itinerary something like this: Idlewild, Bermuda, Azores, Lisbon, Madrid, Rome, Athens, Istambul, Beiruit, Jerusalem, Cairo, Baghdad, Teheran, Kabul, Karachi, Bombay, Colombo, Calcutta, Rangoon, Bangkok, Saigon, Hong Kong, Manila, Teipeh, Seoul, Tokyo, Wake Island, Hawaii, San Francisco, Idlewild. This could give us an average of about two days each in thirty countries.

We need a minimum of ten for the trip. If you are interested in such a tour please let me know. If we can get ten together for it we're in business. We will be taking along some transceivers and operating in as many countries as we can along the route. Since this will be an official club tour we might be able to get special permission in many interesting places. We can beat the rainy season in the far east if we start in mid-April and return in mid-June.

Another trip we are working on is less ambitious. This would run us through Scandinavia. Stops would be made for about four days in each city at: Copenhagen, Oslo, Stockholm, Helsinki and Berlin. Three week tour. We had in mind making this trip next fall in early October since the weather is at its finest during those days and hotel accommodations are not difficult for groups. The cost of this trip, including hotels and breakfasts, will probably be close to $550.

Wrappers

Each month my copy of CQ arrives all battered and torn. I think of this as I order more wrappers for mailing 73. Things must be getting really tight down at CQ if they have to omit the wrapper. I just took a look at the invoice to see what these pieces of kraft paper cost. Like to make a guess at how much I would save if we mailed 73 with just a sticker and no wrapper? Well, a full years supply, 12 wrappers costs just a hair over 2½c. Yes sir, I could save 2½c a year on each subscription if I didn't buy wrappers. When we get that hard up I suggest that you stop subscribing because we are about to fold up.

Another Contest

CQ magazine decided to run a silly VHF contest August 24-25th. I decided to make them sick by entering it. The rules were so unbelievably vague that I wrote them a letter asking for clarifications several weeks before the contest. That's right, no answer.

Since several of the six fellows up here with us for the summer had been working on setting up the VHF station on 73 Mountain, I had hopes that we might be in business by contest time. I tore myself away from the magazine just as the contest started and porsched up to the mountain. Yep, nothing was working. Fortunately the 96 element two meter beam had been put up a few days before and was functioning. The rig was full of parasitics so I had to get it tuned up. It worked pretty well once I had it neutralized. Two was completely dead until I tried a new converter. . . . I think someone fed some rf into the old one.

On six meters we were still using the three element Hi-Par Hilltopper out on the porch. Within a couple of minutes I had the Clegg Thor plugged in and working.

When I started the contest I had in mind working at it for a few hours and then quitting once I had New Hampshire sewed up. I reckoned without K1PDA up on Pack Monadnock. He operated only on six meters and was on there every minute for the 24 hours of the contest. He made over 250 contacts in (I believe) 36 counties. I worked 35 counties, but gave up at midnight after working only 74 stations. I wanted to stop at 73, but a chap in Maine came on and I couldn't stand it.

Shortly after getting going I discovered that the big beam on two meters gave me quite an advantage. I hit 88 contacts by midnight in 53 counties and decided that that was enough. I took it easy during the contest, making a few contacts on one band, talking to the many visitors, getting a snack, answering the phone, trying the other band for a while, and so forth.

It is probably my age creeping up on me, but I find that I have markedly less enthusiasm for all night contests now than I used to. Judging from the quiet that settled over the bands after midnight I was not alone. Only a small handful of youngsters sat it out. When we run a VHF contest I'll bet that it will not run for 24 hours. Maybe something running from noon until midnight, which would give fellows time to get set up in favored locations in the morning and pack up for home at midnight. We'll see.

New Publications

As if we aren't in enough trouble trying to keep up with the demand for 6UP, here we are announcing another monthly bulletin. This brings us to a total of five bulletins we are putting out on our little offset press here at HQ.

It struck us that there is a need for a monthly bulletin devoted to the world of ham con-

tests. Only a few of the big ones are reported in any depth in the regular ham publications. A bulletin devoted to detailed rules and results of contests should be of interest to the ham contester as well as a big help to the clubs who are sponsoring the contests.

This new bulletin will be called "5-7-9," the usual signal report sent during contests. This is consistent with our numerical type publication names too. The first issue is scheduled for October first. The yearly subscription to 5-7-9 is $2.

Clubs planning to run contests of interest to all amateurs are invited to send the date and time of your contest as soon as it is decided, the rules as soon as they are available, and then, after the contest has been run, a preliminary announcement of claimed high scores and a final report on results for publication in 5-7-9. Send your info to 5-7-9, Peterborough, N. H. Make $2 checks (or send cash) payable to 73.

We think this bulletin system of providing specialized information is a great system for it leaves the pages of 73 free to be used for information of interest to all readers and lets us give the specialized news in depth. We might just be interested in publishing bulletins on many more special facets of ham radio if we could find some good editors who would take on the responsibility of getting the bulletin in our hands ready for printing each month in exchange for a percentage of the subscription fee. Many more fields could be covered, such as traffic handling, certificates, DXing, mobile operation, RTTY, etc.

Mensa

Life magazine surprised me recently (August 16th issue) with a Special Report on Mensa. This is a club made up of people with above average I.Q. Virginia and I joined back in mid-1960 when it first came to the U.S. from England. We were both tickled to find ourselves mentioned in the article, though obliquely, as two of the original six who founded Mensa in the U.S. and got married and haven't been seen since. Actually we got married and disappeared into the pages of 73 and thence to New Hampshire. We're still Mensa members. We were a little sorry to see them drop the entrance qualifications from the top 1% of the population to the top

2%, but then I guess we like to have things big here in the U.S. and there are now 900 members in this country, with 3500 worldwide.

ADS

Our advertising rates are so low that it is embarrassing to print them. But I have good logical and valid reasons for them being this low. Perhaps I am being illogical again, but it seems to me that any prospective advertiser would normally want to get the best value for his money. Advertisers in 73 are bringing you more pages of articles to read. They are not spending a good portion of their advertising dollars on a 56 foot yacht for me to retire on, or on the unbelievable rent for a full floor of a mid-town Manhattan office building, or on a new Cadillac every year, or on lavish entertainment of friends in night clubs. Advertising dollars in 73 buy pages. Period. Oh, they also buy results.

	1X	6X	12X
2 pages	$420	$388	$356
1 page	220	204	188
½ page	114	106	98
¼ page	60	56	52
2"	32	30	28
1"	17	16	15

Red second color: $25 per page or fraction. N/C on full pages on contract six or twelve times. Bleeds 10% extra.

6UP ad rates: 1 page . . . $30; ½ page . . . $15. No smaller ads. Both magazines come out on the 15th of the month. Ads should be in our hands by the first of the month at the latest.

May I remind readers that it is the advertisers who make this magazine possible. Without them there would be no magazine. Remember this as you read through 73. Remember this when you talk to prospective advertisers.

73 News

In addition to the latest news in ham radio, Marvin VE3DQX, in his monthly 73 News Bulletin, covers those items which have appeared in newspapers during the month. We would appreciate your help in this. Please, if you see any mention of ham radio in a newspaper, tear it out and send it to Marvin Lipton, 311 Rosemary, Toronto 10, Ontario, Canada.

If you are interested in the latest happenings in ham radio, if you are an officer of a club, or the editor of a ham club bulletin you will be sorely distressed if you are not subscribing to 73 News. $1 per year.

W1FZJ

Further back than I like to remember I used to spend a great deal of my operating time down on the low end of the 75 meter band. One of the inhabitants of that area was W8UKS, Sam Harris, out in Burton, Ohio. We talked a lot and became pretty good friends. We both enjoyed DX'ing down there too. But Sam was much better known for his VHF work. I believe he was the first W8 to poke a signal into the east coast and he was the one you listened for when there was a chance of the band being open or a slight whisper of aurora.

In 1951, when I moved out to Cleveland as a television director, I naturally brought along a rig. This closer touch with Sam resulted in me driving over to see him one day. Good Lord, a beard! But even more impressive was his station, which consisted mostly of a huge old self-supporting broadcast tower up on the top of a hill. Next to it was the beginnings of a house, consisting mostly of basement and some building materials. Sam, together with his wife Helen and his two children, Pat and Midge, were living there until he finished the rest of the house.

As the RTTY bug bit deeper into me I gradually dropped out of my old 75 meter haunts and spent most of my hamming time hunting and pecking at the TT machine and building converters. I did write a couple short pieces for Swap and Shop, which Sam edited. Then Sam moved east, up near Boston, and I didn't hear anything from him for quite a while.

In January 1955, when I took over editorship of CQ, one of my first editorials decried the lack of a VHF column in CQ and I asked for someone to volunteer to run one. Quite a few fellows spoke up and I was having a difficult time deciding until a note from Sam arrived and that was that. I felt that his experience in VHF's, his almost encyclopedic understanding of the technical aspects and his quiet wit would be a winner. I was right.

In 1960, when I left CQ, Sam also left, and for one of the same basic reasons: why continue to put in all that work when you have no idea of when you are going to get paid? I believe they were about a year and a half behind on paying Sam and I think they still owe him an enormous sum. I know they do me.

Sam's popularity, though it had apparently escaped the notice of CQ's publisher on paydays had not escaped Budlong, the then virtual dictatior of the ARRL. Sam was made VHF editor of QST.

Perhaps you remember that Sam built the first working parametric amplifier (on six meters) and is today recognized as the leading expert in the field. Until he went with Tapetone (Telco) a bit over a year ago, he had been chief engineer at Microwave Associates. His

intense interest in ham radio had a lot to do with his change to Tapetone, where he hoped to produce a long line of ham VHF gear. Unfortunately merchandising didn't keep up with engineering and Telco had to drop out of the ham market to make ends meet.

This seemed like a shame to me and I could see ham radio as the loser. I grumbled so much about this that Val K1APA, our number one hand, got to working on the problem and came up with some financing and an agreement with Sam to get back into the ham business again. I'm happy to see Val go out on his own like this and I'm sure that Sam is happier than he's been in ages. I'll probably get my licks in a bit with their advertising, as I do with Waters, Meshna, and a few others with more courage than sense.

Val and Sam are rushing a bunch of products to be sold as Red Line. Why? "Well, red is a nice color."

Big Blow

The Windblowers VHF Society have a certificate for you if you can work W2NUL in Pennsylvania, K2KSH in New York, W2NLN in Connecticut and W2ZRD in New Jersey on two meters on September 28th from 1400 to 2400 local time.

I.L.

Though the furor over incentive licensing and restricted voice bands is dying down, I see that QST still manages to round up a few letters in favor of their stand each month. I don't know where they get them. We're preparing a bulletin of reprints of the best letters we've received on the subject, both pro and con, which will go out to all IoAR Bulletin subscribers ($1 year). The Bulletin is unbiased and lets the letters speak for themselves.

The September QST editorial invokes the spectre of the next Geneva Conference (and well they might, for it is a foreboding spectre) with the implied threat that unless we shape up we are likely to lose frequencies.

I agree that we are quite likely to lose a lot of our best frequencies, but I don't think that the technical level of our amateurs is going to have a lot of effect on the outcome. I do think that this might be a very poor time to make any moves which could possibly lower the number of stations active on our ham bands.

It seems to me that this whole negative approach is a poor one. I've got some ideas that might be helpful, but I've ranted on much too long this month and will save them for a later issue.

73 parts kits

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER PREAMPLIFIER. Uses two 6CW4 nuvistors in a grounded grid input circuit (March '63 p8) and one 6CW4 nuvistor grounded grid output. Complete with power supply. Uses 50 volts on the plates for extraordinary noise figure. Full scale drilling template supplied.
W9DUT-1 .... $18.50

QRP TRANSMITTER. Have fun with this little one half watt CW rig on 40 meters. Uses any 40M surplus crystal. Kit supplies 1S4 tube and socket, condensers, resistors, coil, rf choke, terminal trip, etc. Runs from flashlight battery for filament and portable radio 67½ volt B-battery. See March '63 p22
W1MEL $6.00

15-20 METER NUVISTOR PREAMPLIFIER. Need more hop on these bands? This simple to build preamp will bring up those signals. This is particularly good for inexpensive and surplus receivers. See April '63 page 40
W6SFM-1 .... $4.00

TRANSISTOR POWER SUPPLY. Voltage regulater adjustable power supply for running transistor equipment. Takes the strain off those transistor batteries. Great for the test bench. See April '63 page 8. Uses five ransistors, one zener, cute little (expensive) meter, etc. Will deliver up to 100 ma continuously, voltage from 0.35 to 15.0.
W1ISI $25.00

TRANSISTOR TRANSCEIVER. One of the most popular kits we've ever assembled is this six meter miniscule transistorized transceiver. Really works. Hundreds built. See page 8 in the May '63 issue. Five transistors.
K3NHI $25.00

CW MONITOR. Connects right across your key and gives you a tone for monitoring your bug. Page 44, June '63.
WA2WFW $4.25

TWOER MODIFICATION. Increase your selectivity considerably by installing a new triode 7587 nuvistor stage. This is our best selling kit to date. Everything you need for the modification is included. See June '63 page 56
K6JCN $6.50

SIX METER CONVERTER, DELUXE. 6EW6 low noise front end, 6U8 oscillator and mixer. Output is 10.7 mc (easy to change to suit your needs). This is a tunable converter with fixed frequency output, not the usual converter that requires you to tune the receiver. This helps considerably on eliminating interference from nearby high power stations. See page 8, July '63.
W9DUT-2 .... $20.00

TUNING EYE KIT. This kit enables you to install a dual tuning eye in any transmitter to indicate the tuning of two or more stages. It works far better than a meter or even meter switching. See page 22, July '63.
K6GKU $7.50

NOISE GENERATOR. Invaluable test instrument for tuning up rf stages, converters, etc., voltage regulated by a ener diode. Kit includes even the battery and mini-box.
K9ONT $5.00

CAST IRON BALUN. Eentsy balun using ferite core, covers 6-40 meters, will handle up to 20 watts, complete with cabinet, connectors, etc. See September 1963 page 8.
W4WKM-1 .... $3.00

BOURBON S-METER. Much better than the usual Scotch S-meter. Here is an S-meter kit for those of you with receivers without S-meters. Includes tube, adjusting pot., socket, resistors, and meter. See September 1963 page 18.
W6TKA-2 .... $6.50

NEW PARTS KITS

Bowing to reader demands for us to enkitify some of our past construction articles, we hereby present three new parts kits.

TONE MODULATED CRYSTAL STANDARD. Uses one tube and one mc crystal to generate 1 mc markers all the way up through 225 mc. The built in tone generator makes it possible to easily identify the markers. Including Minibox, tube, crystal, etc.
W9DUT-3 .... $15.00

TRANSISTORIZED MODULATOR. 40 watt modulator, excellent for plate modulating mobile rigs, four transistors, uses 12 volts dc, only draws 250 ma while resting with peaks of 4-5 amperes. Kit includes transistors, transformers, resistors, condensers, etc.
VE7QL $27.50

SHORT WAVE CONVERTER FOR HAMBAND RECEIVERS. One tube short wave converter so you can tune SW broadcast stations. Power supply included.
W2LLZ $13.00

OTHER 73 BULLETINS AND BOOKS

6up. Monthly VHF magazine, editor Jim Kyle K5JKX, technical articles and latest VHF news from all over the country. $2.00 per year.

ATV Bulletin. Semi-monthly bulletin for the ham TV enthusiasts. Technical and operating news. $1.00 per year.

5/7/9. Monthly bulletin for those interested in contests. Lists all contests being held, gives rules and results on contests not covered in QST or CQ. $2.00 per year.

73 News. Published monthly, editor VE3DQX. Keeps you up-to-date on current ham events.

In valuable to club officials for discussions at club meetings. Good source material for club bulletins. 1.00/year.

Ham-RTTY. This is the most complet book on the subject. Written for the beginning TT'er as well as the expert. More complete and authoriative than books at twice the price. Pictures and descriptions of all popular machines, where to get them, how much, etc. $2.00

Bound Volume 1. Gorgeously bound library volume (bright red) of the first fifteen issues of 73. This is the only way to get a complete set of the early issues of 73. We'll pay $1 each for copies of the January 1961 issue in good condition so we can make a few more bound volumes. Covers October 1960 through December 1961. $15.00

Bound Volume 2. Complete matching volume covering 1962 issues of 73. $15.00

Binders. Bright red leather binding. Specify which year you want stamped on them: 60-1, 62, 63. Darbs. $3.00 each.

Back Issues. Since each issue of 73 features articles of a fairly timeless nature each back issue is just as much fun reading as the current issues. All back issues except January 1961 (we'll pay a dollar for these if you can find any) are on hand, some in mighty small quantities. 1960 issues $1.00 each. February 1961-date 50¢ each.

Care and Feeding of Ham Clubs—K9AMD. Carole did a thorough research job on over a hundred ham clubs to find out what aspects went to make them successful and what seemed to lead to their demise. This book tells all and will be invaluable to all club officers or anyone interested in forming a successful ham club. Hundreds of grateful letters have been received from clubs who have applied the ideas in this book. $1.00

Simplified Math for the Hamshack—K8LFI. This is the simplest and easiest to fathem explanation of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc. If our schools ever got wind of this amazing method of understanding basic math our kids would have a lot less trouble. 50¢

Index to Surplus—W4WKM. This is a complete list of every article ever published on the conversion of surplus equipment. Gives a brief rundown on the article and source. $1.50

Ham-TV—WØKYQ. Covers the basics of ham-TV, complete with how to get on the air for under $50. Not the usual theory manual, but a how-to-do-it book. $3.00

Surplus TV Schematics. You can save a lot of building time in TV if you take advantage of the real bargains available in surplus. This book gives the circuit diagrams and info on the popularly available surplus TV gear. $1.00

AN/ARC-2 Conversion. This transceiver sells in the surplus market for from $40 to $50 and is easily converted into a fine little ham transceiver. Covers 29 mc (160-80-75-40 meters). This booklet gives you the complete schematic and detailed conversion instructions. $1.00

AN/VRC-2 Conversion. Completely different from the ARC-2. This book gives you complete instructions on converting the inexpensive VRC surplus gear into a six meter wide band FM transceiver. There are probably over a thousand stations now operating on 52.525 mc around the country. Join the crowd. Fun. $1.00

Coils—K8BYN. Basic book which covers the theory and practical aspects of the many different types of coils found in ham work. Well illustrated. 50¢

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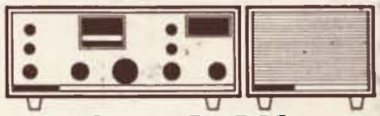

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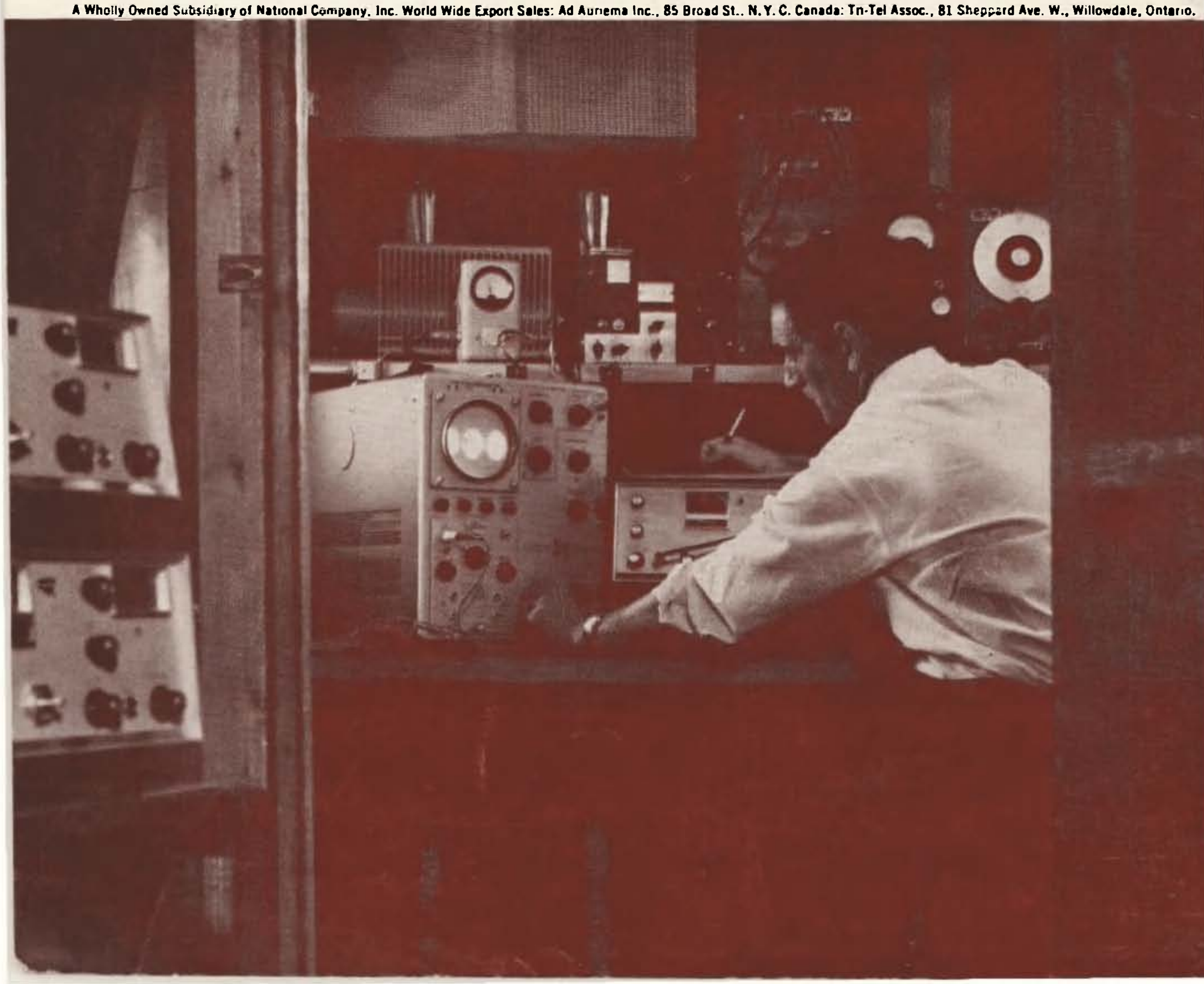


73

November 1963
Like . . . 40c

Amateur Radio

ANNUAL NOVEMBER ISSUE

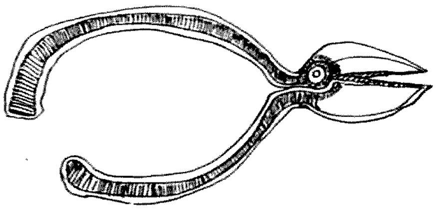
featuring

Tool and Workshop Practices for the Ham

and about 20 other much more interesting articles

73 Magazine

Wayne Green W2NSD/1
Editor, etcetera



November, 1963

Vol. XIV, No. 11

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de W2NSD/1

never say die

When someone called up the other day to let me know that the ARRL was indeed going to send in their restricted bands petition to the FCC, we both marveled that they would go ahead with this in the face of the violent opposition of such a large proportion of the amateurs and the disinterest shown by the FCC.

The petition, as I understand it, calls for the segregation of our phone bands on a three year schedule. First to go would be the favorite, 20 meters, which would be for Class A only (Advanced Class) starting in 1965. Then 40 and 15, and finally 75 meters. The full grim details are supposed to be in the November QST.

Since the ARRL has not yet been able to come up with any reasonable excuse for this attempt to step backwards, we wonder what they have up their sleeves. They certainly must have something, for otherwise their attempt is bound to fail and they surely must know this.

As you may have surmised from reading my editorials for the last few months, I have been following this situation closely and watching for the League to present an explanation that doesn't insult the intelligence of the average ham.

If all goes as planned by the ARRL the General and Conditional Class hams will have only two little shreds of 160 meters and from ten meters up if they want to operate on phone in three years.

I think this is lousy.

I'm not alone in this opinion. We are in the midst of preparing a booklet of the letters received on the subject of incentive licensing. It has been my past experience that an editor normally hears mostly from people who disagree with him, while those who agree nod their heads and let it go at that. I have been rather outspoken against this move and never before have I been so firmly backed up by my mail. In addition to the many agreeable letters I also received a considerable number of copies of letters sent to QST and their officials. A few negative letters came in also and they will be included in the booklet. If you are interested in reading a close approximation of what the League probably received in answer to their editorials then send in a SASE, or $1 for this plus the next few IoAR Bulletins. Good reading.

So what *is* the reason behind the ARRL petition? No one really knows. Some suggest that this is a pet project of the one or two old timers who seem to be running the League these days. Those of us who are still around remember what a good deal the handful of kilowatt ops had in pre-war times. The Class A bands were only 100 kc wide and held about eight or ten roundtables. It was no place for the low power op. The kilowatt boys had the bands to themselves and they loved it. I can easily understand how nostalgia might dictate a return to those glorious days.

On the other hand, since one obvious result of Class A phone bands would be to force many thousands of ops back onto CW, many fellows are pretty well convinced that this move is just another in a long line of pro-CW actions by the League. Back in the pre-war days, when about 70% of the amateurs operated CW and about 50% didn't even have a modulator, the shortage of phone bands for Class B was of little moment. But today we have to look far and wide to find fellows who can't go on phone. What with SSB transceivers and thousands of mobile stations, the restriction of phone bands would create a great hardship.

One of the ARRL Hq staff told me in confidence that the whole purpose of this "incentive licensing" escapade was to create controversy. The idea behind this was to make the League more talked about so that more amateurs would subscribe to QST. They certainly have succeeded in getting the ARRL talked about, but unless there are an awful lot of liars writing to me saying that they have not renewed their subscriptions to QST this scheme has backfired. Suppose the QST boys are able to put their bill through? What then?

As an Advanced Class licensee I would find 20 meters a lot easier to use for about 75% of the operators wouldn't be able to use it. This would make DX'ing simpler, but it would also prevent me from contacting a lot of friends that I've been talking to for years. Eventually I suppose 75% of them would get their Advanced Class license and be back on. But a percentage of them either through anger at what had happened to them, laziness, or too much other busines would never be heard from again.

Another great advantage would be the bargains in both new and used equipment that I would find. With thousands of amateurs dropping out of radio the prices would plummet and I could pick up incredible bargains.

As more and more manufacturers went out of business I could build up a fantastic hamshack at fractions of the old prices. This would have its disadvantages too for there certainly would be little new coming out into such a depressed market and it would probably be many years before any company came out with anything really remarkably new.

Though a return to Class A licensing would probably help 73 at first through the sales of thousands of copies of an Advanced Class Study Manual and increased advertising by frantic manufacturers and distributors, in the long run it would hurt.

In summary: as things look now I don't see how the League can possibly hope to succeed with their petition. The FCC doesn't hoodwink easily. Neither do most hams. I believe that I can safely say that unless there is some development that is not even forseen right now that the ARRL hasn't got a chance of getting our regulations set back 25 years. There is no denying that they have gotten a lot of publicity out of this though, so perhaps they will achieve their main goal even if they lose the battle.

Technical Improvement

While the ARRL is trying to decide what laws to try to jam through to force you to learn more of the technical end of ham radio, why not show them up by setting up a little self-improvement plan of your own? Perhaps I am wrong and it is necessary to throw most of the hams off the air for a while to get them to learn a little more theory. I don't think so.

Let's take you, for instance. How about you doing something about technicalizing yourself? Forget all those excuses about not having time, beding too old to learn, and all that rot. You can, at home, in your spare time, become quite an expert on radio and it won't cost you much either. It really needn't cost anything extra unless you want to invest in some reference books.

What is my magic answer to this great problem? It is so simple I hesitate to tell you. You'll just laugh it off and there we'll be. If you were to take the time each month to read every technical article in 73 and make sure that you understand it you would soon find yourself with an impressive understanding of radio. You don't have to invest in a bunch of text books, license manuals, and like that.

Sure, you'll run across parts of the article that you just don't understand. This is an important part of the learning process. By the time you've talked these problems out with fellows on the air or at your own ham club you will really

(Turn to page 96)

Another Approach to TVI

Harmonic Reduction

Jim Kyle K5JKX
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Oklahoma City 11, Okla.

TVI giving you trouble? Does your peanut whistle wipe out local channels just as if it were a kilowatt? Or are you maybe in the process of planning that next rig, and want to avoid any problems with the Tennessee Valley Indians?

Hundreds of thousand of words have been written on the subject of TVI—but very few of them have really brought out one point which is of special interest to the VHF-minded ham who happens to live in a semi-weak-signal area (and this includes almost every place in the world, when you stop to think of those almost-out-of-range stations which a few people enjoy watching!).

This almost-neglected point is simply that unwanted multiples of the original frequency are one of the most prolific causes of TVI from VHF transmitters! Almost any design will be sufficiently free from 50 mc harmonics to stay out of trouble; most will be safe when it comes to 25 mc harmonics as well. But the design practices commonly followed in VHF gear almost insure that plenty of harmonic energy still makes it to the feedline from the oscillator!

Consider, for example, a 6-meter rig operating on 50.250 mc, from an 8375 kc crystal. The oscillator produces some output at 8.375 mc, 16.75 mc, 25.125 mc, 33.5 mc, 41.875 mc, 50.250 mc, 58.625 mc, 67.0 mc, 75.375 mc, etc. on up the scale. That harmonic at 58.625 is right in the middle of Channel 2. The one at 67.0 is only 250 kc away from the video carrier of Channel 4. The 75.375 mc harmonic is just 625 kc away from Channel 5—and many TV-set front ends will let it right on in!

But, you may say, the tuned circuits between the oscillator and the final keep these harmonics down.

And that is where, in all too many cases, you're dead wrong!

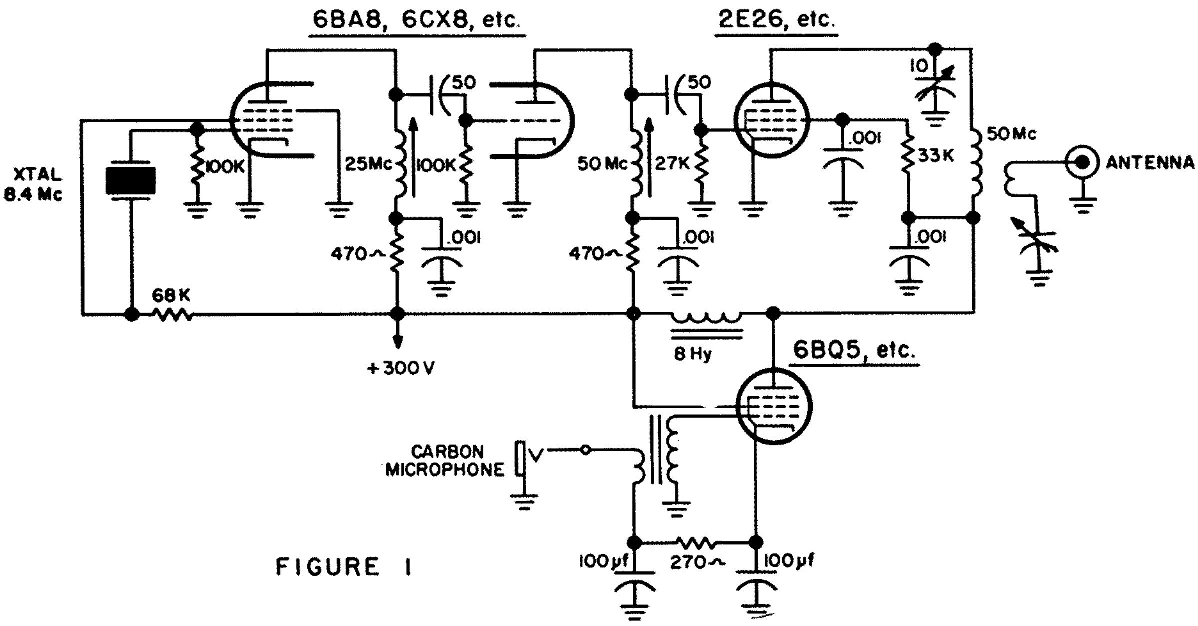
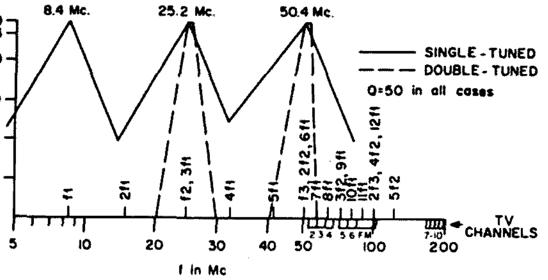


FIGURE 1

Typical circuit for simple 3-tube 50 mc rig: similar coupling circuits are to be found in many units now operating although oscillator arrangement is unusual as is modulator.

Fig. 1 shows the schematic of a typical three tube 50 mc peanut whistle (it's not taken from any particular design, but the basics are there). Note that only *two* tuned circuits separate the oscillator and the final output circuit. The 25 mc tank between the oscillator and the driver makes sure that the wanted third harmonic of the crystal gets the most boost—but the second, fourth, and fifth do pretty well also. Even the seventh and ninth get through to some degree. Then when these harmonics from the fifth up (40 mc to around 90 mc) hit the 50 mc tank in the driver plate circuit, they get another boost. They're too close to the 50 mc desired output frequency to be held down very much in the final tank, and boom!—out the feedline they go. The result? Galloping TVI.

If you're interested in seeing how this works, Fig. 2 is an approximate graph of the selectivity curves of single-tuned circuits (solid lines) against frequency. You can see that the unwanted harmonics are attenuated some 20 db or more—but this isn't enough to get rid of the TVI problems.



Selectivity curves of single-tuned and double tuned circuits in typical VHF transmitter. F1 is crystal frequency, F2 is tripler output, and F3 is final output frequency. Note how oscillator harmonics hit TV channels if allowed to get out; note also difference in skirt selectivity between single-tuned and double-tuned circuits.

So what can we do about it?

The simplest answer is to switch from the single-tuned circuits used in Fig. 1 to double-tuned circuits, coupled in such a way that the unwanted harmonics are reduced enough to be considered eliminated. But unless you do a little planning, you'll end up with circuits so selective that you have to completely retune the rig from the oscillator on, every time you change frequency as much as 100 kc. This may be fine for fixed-frequency mobile rigs, but it's one big pain in everyday operation!

The lazy man's answer to this is to make all the circuits bandpass (with a wide enough passband to allow QSY up to a megacycle or so at the output frequency. And before you run away, let's hasten to add that making the circuits bandpass isn't near so difficult as you may have been led to believe in the past!

The absolute bandwidth in cycles per second of any tuned circuit depends on just three factors—and you can control two of them easily. In fact, if you happen to have a commercially-built transceiver using single-tuned circuits a la Fig. 1, you will find it a relatively simple job to make it bandpass! And if you're starting a new rig, you'll find it no trouble at all to add the bandpass feature from the beginning.

Before we get into the how-to-do-it, though, let's take a look at some of the theory behind this whole business of selectivity. It will help immensely when you get around to designing your own application of these ideas.

As mentioned a couple of paragraphs ago, the absolute selectivity in cycles per second of any tuned circuit depends on just three factors: the frequency at which it operates, the Q of the circuit, and (in the case of double-tuned circuits) the coupling between tanks.

If *any one* of these factors is varied, the bandwidth will also vary. Bandwidth increases as frequency goes higher, and decreases as the Q is increased. The effect of changing the coupling varies, depending on the level at which the bandwidth is measured.

In a transmitter, the frequency is usually fixed rather firmly and you can't do much about it. Q, however, is a design choice which you can change; and coupling between the tanks is relatively easy to vary.

In selecting the Q at which you want to operate the circuit, several factors must be considered. The most important is that Q must not be too high if you want a relatively broadband circuit. Since this is the opposite of usual procedure, it bears repeating: for maximum bandwidth, keep the Q low!

Air-core coils such as B&W Miniductor and Illumitronics Air-Dux have Q values of around 200 at the frequencies we'll be dealing with mostly. The Q of slug-tuned coils varies with the slug material, the position of the slug in the coil, and the frequency. Since tuning the coil will change its Q, these coils are not recommended for bandpass circuits—but if you want to use them, you'll find Q ranges from about 40 to nearly 100.

At this point you may be puzzled. How, you may ask, do I get that low Q without using a slug-tuned coil? The answer is to invest in a few composition resistors and shunt them across the circuit. This will knock the Q down to any value you want. Then you can use the air-core coils, which also make the coupling situation easier.

Here we've been talking about coupling, but just what does it amount to? Actually, there are many ways of coupling a pair of tuned

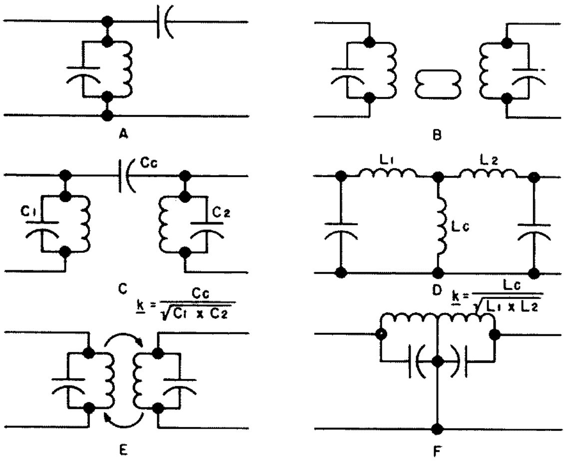


FIGURE 3

Six of the most practical forms of coupling with tuned circuits A) Single tuned circuit B) Link coupled. k varies from 0.16 to 0.4 C) Top coupled k D) Inductive bottom coupled E) Transformer coupled. k varies widely, depending on placement of coils F) "GE Ham News" coupler; special case of circuit E.

circuits—but of these, only a few are really practical. Most of these practical methods are shown in Fig. 3.

The simplest of all, of course, is the single tuned circuit as shown at A—but this is what we're getting away from.

Most widely used in transmitters is the link-coupled version shown at B. This consists of two separate tuned circuits, with a small link wound around the cold end of each and the two links connected together. This has the advantage that the two circuits may be physically separated; in addition, coupling can be varied by the size and position of the link, and since both links can be changed, a wide range of control is possible. The amount of coupling between circuits is usually denoted by the "coefficient of coupling" which is abbreviated k; values of k for typical single links range from 0.40 (small link at end of coil) to 0.63 (large link wound over center of coil). To obtain the over-all figure for two coils, the individual values of k must be multiplied, giving a range from 0.16 to 0.39. Smaller values may be obtained by spacing the link farther from the main coil.

The top-coupled circuit shown at C is easy to calculate in theory, but proves a bit difficult to realize in practice. Its k can be calculated as shown in the illustration, but don't forget to include all stray capacitance in the values of C2 and C3. These strays are what make the top-coupled circuit difficult to use.

Shown at D is the inductive bottom-coupled circuit, which has been popular in past years for VHF converter applications but which has seen little use in transmitters. Like the top-coupled circuit, it's easy to calculate—and unlike the top-coupled, it's also easy to use.

Finally, at E, is the transformer-coupled circuit. The coupling here is strictly magnetic, and depends largely on the spacing between the two coils. With typical ham equipment, it's almost impossible to measure k accurately—and even harder to change it.

The circuit shown at E is a variant of the transformer-coupled circuit first described in "G-E Ham News" several years ago. It has a k value depending almost entirely on the size of the coil, since it consists of a single length of coil center-tapped.

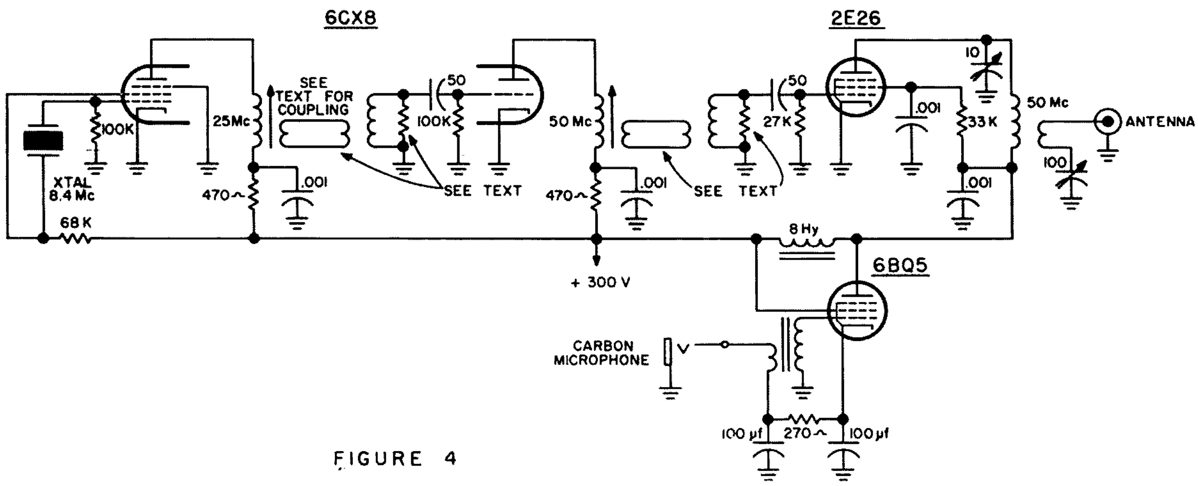


FIGURE 4

Circuit of Fig. 1 modified for bandpass double-tuned coupling between rf stages to eliminate TVI. Note only changes are addition of two grid tanks and coupling links.

Resistors across grid tanks are for control of Q as described in text; this modification may be made to any rig, or this circuit may be used for an economy 10 watter.

For our purposes, the ease of adjustment and freedom from critical physical placement of parts make the link-coupled circuit of Fig. 3-B the easiest to work with. Keep in mind, though, that the same principles apply to all these circuits—there's nothing to keep you from using one of the others if you like.

Now let's look at the *purposes* of coupling the two circuits. There are two of these purposes, one the inverse of the other. The primary purpose, of course, is to transfer power at the desired frequency from one circuit to the other. The other purpose is to prevent power at undesired frequencies from being transferred.

The single-tuned circuit is probably the most efficient there is for plain power *transfer*, but it falls far short when it comes to rejecting undesired frequencies.

So we turn to double-tuned circuits. First let's assume that there is *no* coupling between our two circuits, but that power gets through anyway (this is what happens when we separate two single-tuned circuits by an amplifier stage). The selectivity is somewhat better than a single-tuned circuit, but the top of the curve is still pretty broad.

Now let's couple the two circuits, ever so lightly. At first, we find an extremely narrow selectivity curve—but also very little transfer of power from one to the other.

As we increase the coupling, more and more power is transferred. At some stage, we find that the power transfer rises to a peak, and as we increase the coupling still more we discover the power transfer drops off. However, if we now vary the frequency slightly, we will find that we have two peaks, spaced approximately equal distances above and below the original peak.

As the increase of coupling continues, the peaks move farther and farther apart. At the same time, the dip between them gets deeper and deeper. Finally, the dip is so deep and the spacing so wide that the arrangement becomes useless.

That point at which we discovered the single peak is known as "critical coupling," and strangely enough it always happens that this stage is reached when the product of the k and the coil Q is exactly 1.0. This gives us a relationship between k and Q which we can use to predict other circuit behavior.

For instance, if $kQ = 0.7$, the circuit will have the same bandwidth in the region of its peak as a single-tuned circuit. However, only some 70 percent of the power will be transferred.

With a kQ product of 1, maximum transfer of power will take place, but bandwidth in the nose region will rise to 1.4 times that of a single-tuned circuit.

Raising the kQ product to 2, we find that power transfer is still within a few percent of maximum, and bandwidth has risen to three times that of the single-tuned circuit.

All these bandwidth figures are applicable only in the region of the "nose" of the curve, near the desired frequency. How about down on the skirts of the curve? Say, some 30 db below the level of the desired frequency.

With a single tuned circuit, the 30 db bandwidth is some 50 times as great as the 3 db bandwidth. This is inadequate.

With double tuning and $kQ = 0.7$, 30 db bandwidth is only 7 times as great as that on the nose.

When $kQ = 1$, the 30 db bandwidth is 8 times the 3 db figure of a *single-tuned circuit*. Since the 3 db bandwidth of this circuit is 1.4 times as great as that of the single circuit, though, the 30 db bandwidth of this circuit is only about 5.7 times as wide as its nose.

With $kQ = 2$, 30 db bandwidth is 13 times the 3 db figure for single tuning, or 4.3 times as great as the nose of the single-tuned circuit.

The relationship between 3 db and 30 db bandwidths is important in that it tells us the *shape* of the curve; for this reason, it's called the "shape factor." Shape factor of a single-tuned circuit is approximately 50 to 1. That of a double-tuned circuit where $kQ = 0.7$ is about 7. If $kQ = 1$, shape factor is 5.7. If $kQ = 2$, shape factor is 4.3.

All this time, we've been talking in *relative* terms. Now let's find out how many cycles wide these bandwidths are.

The absolute width of the band, in the nose region, is determined only by the frequency and the Q. Though some engineers might quibble, the approximate relationship is that 3 db bandwidth for a single-tuned circuit or double-tuned circuit when $kQ=0.7$ is equal to the center frequency divided by the Q. Thus a single-tuned circuit at 25 mc with a Q of 50 would have a 3 db bandwidth of 500 kc. If the frequency remained the same but the Q were increased to 200, the bandwidth would drop to 125 kc.

This whole business of bandwidth can be summed up in a table such as that shown here (Table 1).

Table 1. Bandwidth as a Function of Frequency

Coupling	-3 db	-30 db	Shape Factor
Single-tuned	f_0/Q	$50f_0/Q$	50 to 1
$kQ = 0.7$	f_0/Q	$7f_0/Q$	7 to 1
$kQ = 1$	$1.4f_0/Q$	$8f_0/Q$	5.7 to 1
$kQ = 2$	$3f_0/Q$	$13f_0/Q$	4.3 to 1

Thus you can see that to obtain the narrowest skirts (smallest shape factor) the coupling should be larger, but this in turn will increase absolute bandwidth, requiring an increase in Q to trim things back in line.

And if you're questioning, at this point, the earlier statement that all this is simple, relax. You've just completed the *theory* part. Now we're going to put it in practice, and you'll be surprised how little of the theory is really essential to make it work.

The first step, in putting this to work, is to select an approximate Q for the circuit. As a guide, a Q of 50 for all coils will give you a possible 3 mc bandwidth on 50 mc, by overcoupling a bit. If you don't have any means of measuring Q, don't worry—just put in the coils and rig adjustable links between them.

The procedures described from this point onward will probably cause several cases of apoplexy among our more highly trained engineers with fully equipped labs available. There are rough-and-ready ways of doing the job, not precision measurement techniques. Admittedly, they are not highly accurate— but they will work.

With the links in place, you're ready to find out just what the Q and *k*Q values you actually have really are. Start out at the final stage. Hook in a grid-current meter (if your rig doesn't have one) and leave the final plate and screen voltage off. Couple a grid-dip oscillator or high-output signal generator to the grid of the driver and drive it at *output* frequency. Monitor the frequency with your station receiver, using the highest harmonic you can to make the readings more accurate.

First, tune both of the tuned circuits you're adjusting to center frequency. To do this, hook a 2200 ohm resistor across one tank while tuning the other, to swamp out the tank not being tuned. Center frequency, incidentally, is that spot halfway between your desired band edges; it would be 51.5 mc if you want to cover 50 to 53 mc.

Now adjust the coupling from the GDO to the driver to get as much grid current as you can; note the grid current reading. Then adjust the GDO frequency downward until the grid current drops to 70 percent of its original value (don't worry if it goes up first—it will, if your circuit is approximately correct to start with) and note the frequency at which this happens. Subtract it from your center frequency, multiply by 2, and you have your 3 db bandwidth.

Keep tuning downward until the grid-current reading falls to 3.2 percent of its original value; this may be a mite difficult to read if the original grid current was less than 10 ma,

since with a 10 ma original grid current this figure would be only 0.32 ma. However, try to get it as accurate as you can.

Then subtract the frequency at which this happens from the original center frequency and multiply by 2 to get the 30 db bandwidth. Divide the 30 db bandwidth by the 3 db bandwidth to find out the shape factor.

Also divide the center frequency by the 3 db bandwidth, to find out the original circuit Q.

Now a look at Table 1 in this article will tell you the approximate value of *k*Q for your circuit, by comparing your measured shape factor with those listed. The final calculation gave you the effective circuit Q.

For the best harmonic reduction consistent with wideband operation, a *k*Q value of 2 is recommended. If your *k*Q value is too small, increase the coupling somewhat by moving the link on one or both coils.

If the *k*Q factor is right but the actual bandwidth is too small, lower the Q by shunting a composition resistor (100K is a good value to start with) across each coil. Increase the coupling to keep the *k*Q value approximately the same.

After each variation of the circuit, repeat the measurement process.

It shouldn't take over two or three trials, once you get the hang of it, to make the bandwidth come out to just what you want while keeping the *k*Q factor (and the resulting shape of the curve) where you want it. Once the final-to-driver coupling is properly adjusted, move to the coupling between oscillator and driver and repeat the process.

The end result will be a rig with essentially constant drive over the entire operating range you want to use, with only one tuning control—the final output.

Some hints to help—if you're working with a very low power rig, you can use the rf voltage at the grid instead of the grid current as an indication. The same ratios apply.

And this works as well with converters or receiver front ends as it does with transmitters, reducing *if* feedthrough, birdies, etc. Here, feed in signal to the grids and measure voltage past the coupling circuit with an rf VTVM.

The only essential difference between the ideas presented here and the conventional link-coupled circuits in wide use is that here, the coupling and Q are adjusted to provide desired bandpass action so that intermediate tuning in the drivers can be eliminated. Existing link-coupled rigs can be modified for easier operation by applying the measurement and adjustment techniques described in this article.

Finally, in case you want to read up on the complete technical and theoretical side of the subject, try the fourth edition of *Reference Data for Radio Engineers* published by IT&T and available from Radio Bookshop. Pages 236 to 246 contain the full details, and the theory portion of this article was derived mainly from information contained in these pages.

Good luck—and happy bandpassing.

. . . K5JKX

(Continued from page 28, October issue)

letter perfect every time, and second, the circuit may have worked for the author by a fortunate layout of parts. Try to understand the operation, see if it is logical, and grid dip the rf coils. Merely because the author's were resonant doesn't make yours resonant. Keep trying and changing, and you'll make it.

30. After the transmitter is built, the adjustment (parasitic suppression, neutralization, "bug" removal) separates the men from the boys.

31. Electrical ground and earth ground are not always the same.

32. Cathodes of a grid driven final work best when taken DIRECT to ground; measure that tube current somewhere else.

33. Usually you get higher efficiency with single band coils in the transmitter or receiver.

34. Lay your *if* strip, audio circuits, rf strip, in physical straight lines on the chassis whenever possible.

35. Shield for TVI, but make it all removable, and don't leave the heat in.

36. Ground all metal cabinets and fuse for the rating of the gadget.

37. An antenna that is adjusted to resonance in one location will probably not be resonant to the same frequency in another location if it depends on the earth as part of the operation.

38. A powdered iron core is frequency conscious, some go much higher than others in frequency.

39. To wind rf, *if*, or antenna transformers for maximum gain, they must be capacity aiding, arranged so that plate connects to start of primary and grid of next stage connects to end of the secondary, both coils wound in the same direction.

40. Just lay the leads in the solder terminations, don't twist them, and then do a good job of soldering after all the leads are in. Twisting merely makes them difficult to remove. The lead will break before the joint breaks if you soldered it properly.

41. If in doubt about a published magazine

article, write the author, he should know.

42. 99 per cent of all the technical problems have already been hashed out by someone else. Check the books and journals and know, then argue if you can.

43. Know what is in your little black boxes, don't be just a knob-twister. There are too many commercial operators on the bands now.

44. Try regulating the filaments in the receiver and exciter. Besides the B+ you'll be surprised at the improvement, and it is easy with solid state.

45. Daisies don't tell.

. . . W5IUR

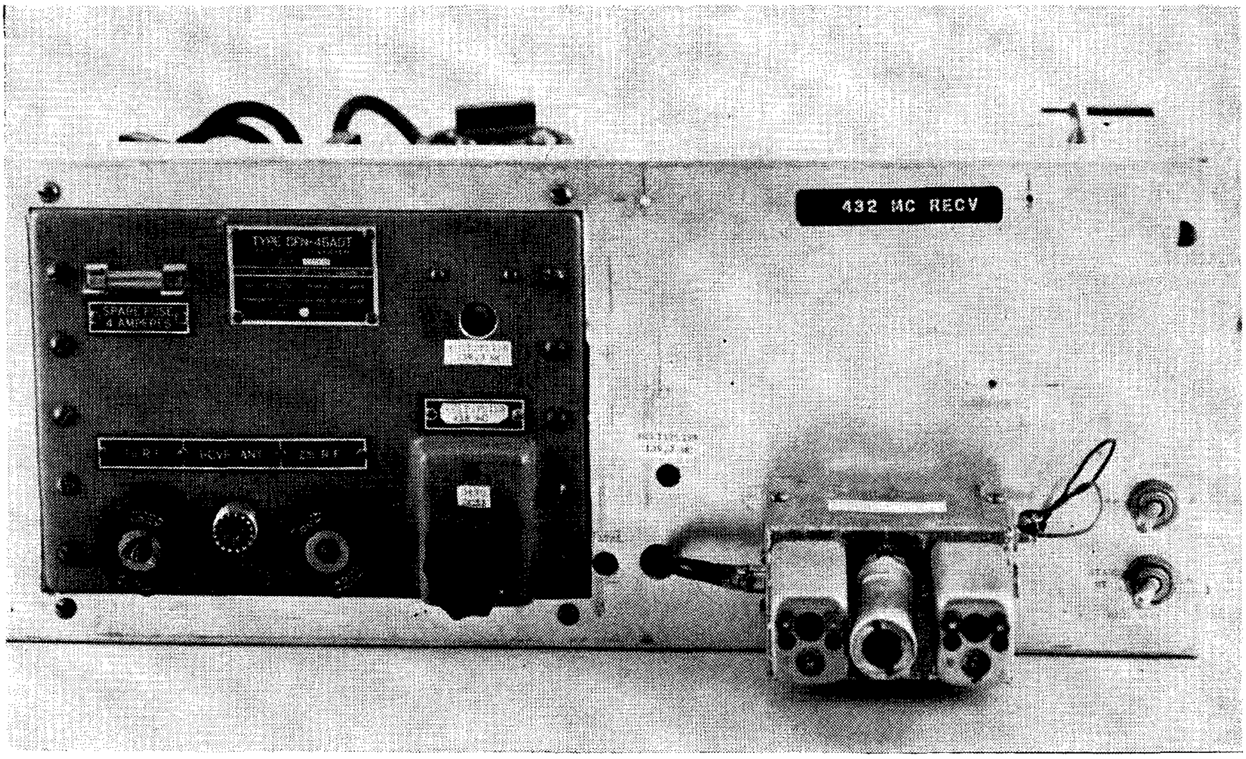
A 432mc Converter

using the Navy surplus CFN-46ADT

Leroy May W5AJG
9428 Hobart St.
Dallas 18, Texas
Photo credit: Jim Dungan KRLD-Dallas

The rf to *if* converter chassis CFN-46ADT is a component of the Navy BP Radio Equipment, which is an interrogator-responder for military identification and is used as a complement to the companion radar equipment to identify the craft being interrogated. Although the complete BP equipment consists of a transmitter, modulator and *if* to video converter, the receiving rf to *if* converter is the only section in which we are interested at this time.

This unit consists of two radio-frequency amplifier stages using type 2C40/446A tubes, a converter stage using a type 2C40/446A



Front panel view of CFN-46ADT unit built into a 432 mc converter.

Plate tuning for 1st and 2nd rf stages and the antenna input is shown marked.

The old oscillator dial now becomes the tripler tuning dial. Xtal and first multiplier adjustments may be adjusted thru holes in the panel.

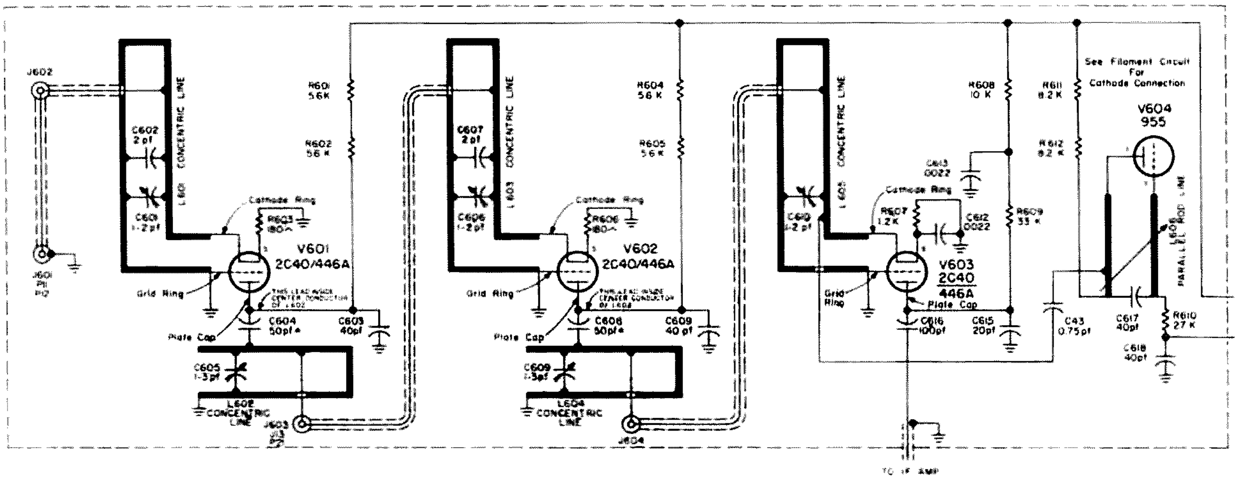
The 14 mc if Amplifier stage is at lower right. In on left, out at right.

tube, and a self-excited local oscillator using a type 955 triode acorn tube. This last named stage will have to give way to something more modern and stable, but the first three named stages will remain as is, more or less. To continue the description, the amplifier stages utilize a grounded grid circuit in which the input is coupled to the cathode and the output coupled to the plate circuit. The grid forms an effective shield between the two circuits (grounded-grid) and reduces feed-back to a negligible value. To obtain uniform results, the plate circuits are loaded somewhat heavier than for optimum output. The input and output circuits are matched to 50 ohm impedances. Both the cathode circuits are pretuned, and the plate circuits are tuned by means of the slotted shafts marked "1st rf" and "2nd rf" on the front panel. Because of the physical arrangement of the input and output jacks, it is possible to jump any one of the stages by merely changing the plugs. Illustratively, the 1st rf amplifier can be jumped by connecting (P602) (input to 2nd rf amplifier) to (J602). The second rf amplifier can be jumped by connecting (P603) (input to converter stage) to (J603) (output of 1st rf amplifier). It is quite interesting to jump stages in this manner and see what happens to the gain and S/N ratio of a signal. Also, other experimental pre-amplifiers may be jumped in to the rf line or directly to the mixer for comparison results.

These rf cavities are beautifully built, silver plated, and are marvels of stability. No tendency towards regeneration or oscillation is present and they will not drift in tuning over long periods of time or with temperature changes.

The converter stage (mixer) is also a 2C40/446A grounded-grid type where both the incoming signal and the signal from the local oscillator are fed into the cathode circuit. The cathode of the mixer is pre-tuned similar to the two rf stages.

The original oscillator stage is a self-excited type Colpitts design in which the tuned circuit is composed of invar open lines and makes use of a type 955 acorn tube. Tuning is accomplished by means of a pie-plate disc coupled to the open end of the line. As before mentioned, this stage will undergo some revisions and will be made into the final push-pull tripler of a crystal-oscillator-multiplier string by changing tube type and revamping the open lines. More later on this subject. A counter on the front panel marked "RECV-OSC" indicates the relative position of the pie-plate capacitor



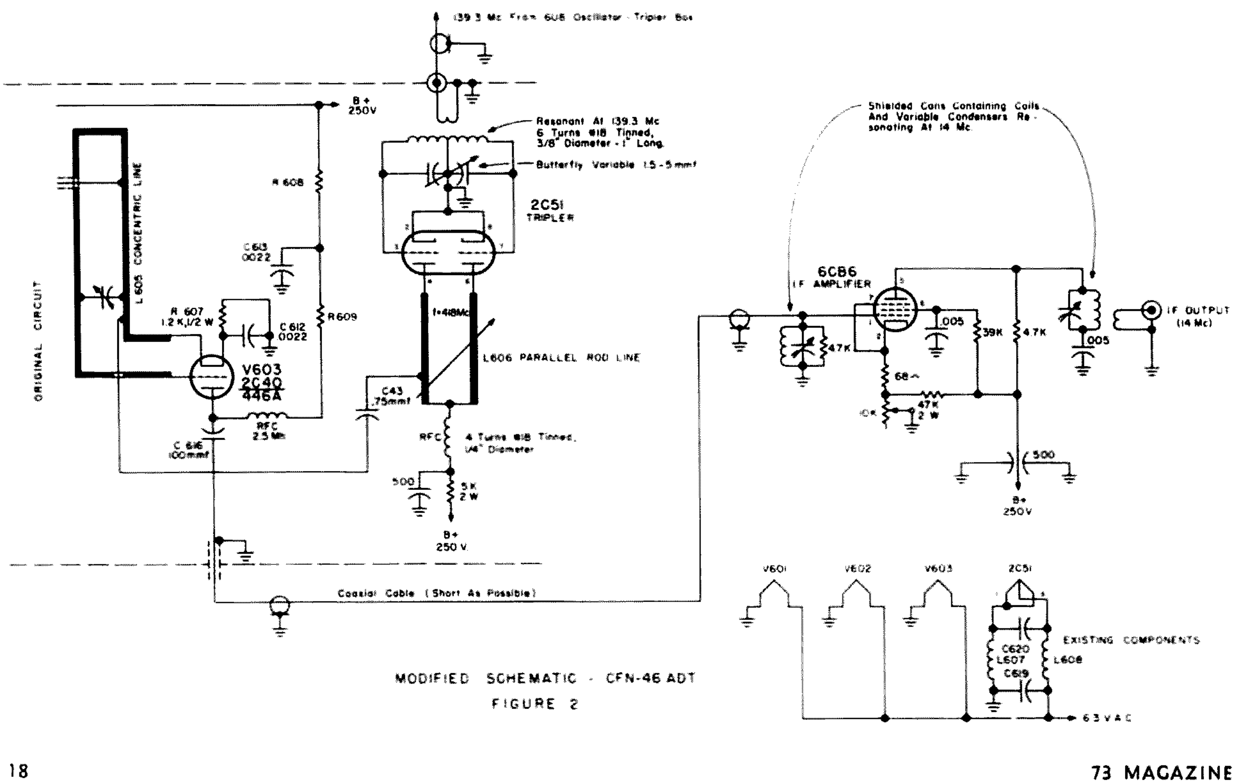
ORIGINAL SCHEMATIC - CFN-46 ADT
FIGURE 1

plate tuning the lines. This will be left as is, and merely relabeled "MULTIPLIER."

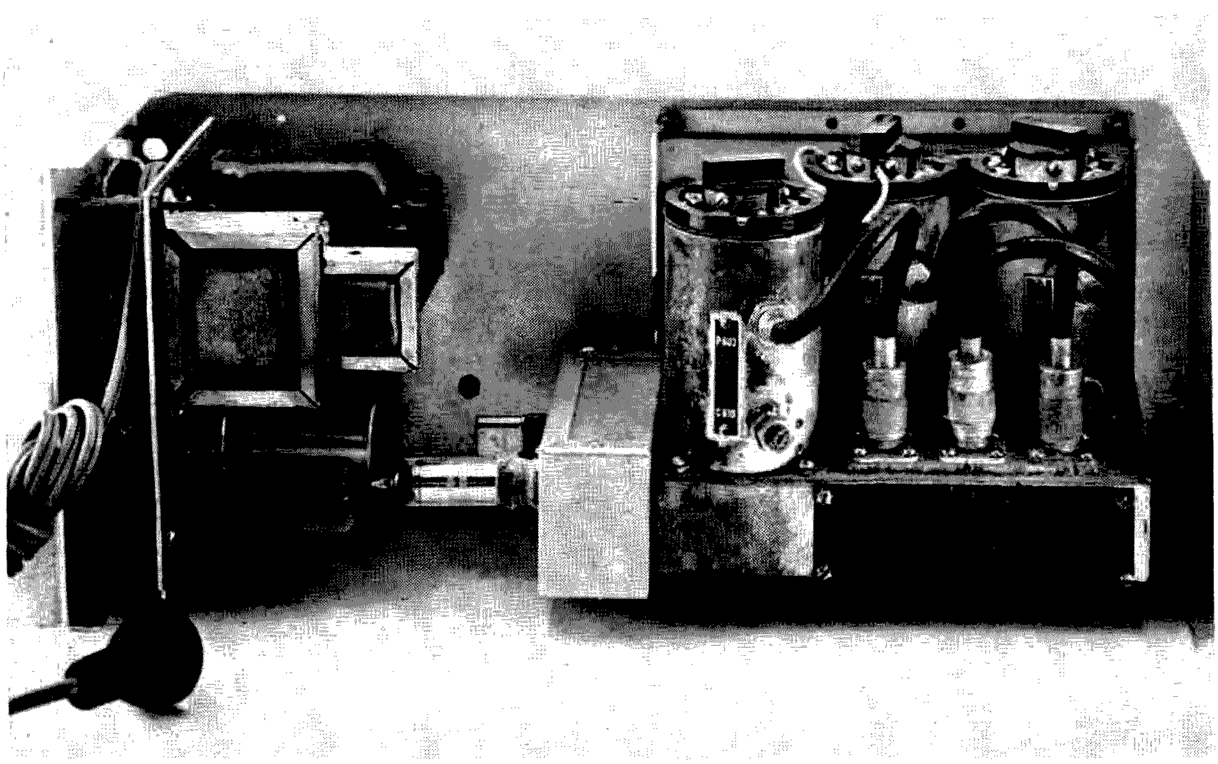
This CFN-46ADT converter was designed to receive a fixed frequency of 493.5 mc, but will tune down to 432 mc with no pain or strain. Absolutely no alterations to the two rf tanks and the mixer tank will be necessary in our first set-up. Only the existing oscillator stage will be modified and additional circuitry in the way of a multiplier chain will be added.

How good will the converter be when completed? This can not be stated to any exact degree, since precise measuring equipment is not available at this station. As far as noise-figure values are concerned, the type 2C40 tube was one of the early answers to the medium low UHF receiving problem and was widely used in radar gear during WWII. No doubt, later type UHF tubes such as the 6299, 7077, 7768 and, more recently, 8058's are better suited (and much more expensive), but the two rf stages of 2C40's with their coax cavity construction will do a reasonably good job even today. At the end of this article, additional suggestions will be presented to upgrade further, if desired, this CFN-46ADT converter, but first we should complete our modifications and get the unit receiving properly for preliminary on-the-air tests.

As far as sensitivity goes, this Navy unit as used in the original BP equipment was rated with a sensitivity of about 6 microvolts. This is



MODIFIED SCHEMATIC - CFN-46 ADT
FIGURE 2



Rear panel view of CFN-46ADT unit.

Power supply equpt. at left. The crystal-multiplier minibox is shown bolted to 46ADT chassis. OB2 regulator tube can be seen as well as crystal.

The tripler to 418 mc using the 2C51 tube is behind the mixer pot and can not be seen.

The 1st and 2nd rf amplifier coax pots are from right to left. The input and outputs of the pots are on standard coax UHF plugs and can be jumped as desired.

for a signal-plus-noise to noise ratio of 3 to 1, and with an *if* bandwidth of 4 mc at 6 db down from the output at the tuned frequency. Since in our case, the converter will be working into a sharp communications type receiver, rather than a broad radar type *if* system, we should be able to beat this by quite a little bit. Certainly it is sensitive to at least a half-microvolt or less by ham standards, but again precision measuring equipment is not available. Generator leak-thru was present below the half-microvolt range, which upset definite measurements.

Availability of the unit? Actually, this is not definitely known either. Most of the 432 mc workers around this area seem to possess one of these units, or have had one at one time or another. Quite a few were distributed in the various MARS programs. They have been seen in various junk-yards, some in excellent condition—even new condition. However, very few people seem to have put them to work. It is hoped this description will be of some help in this direction.

Modifications

As previously mentioned, the first and second rf cavity stages are unchanged from the original. It may be necessary to adjust the series dropping resistors R601, R602, R604 and R605 in the B plus plate line, according to the supply being used to power the converter. This will be discussed under "Operation."

The rf cavity mixer stage V603 will require a few changes. Actually, the coax cavity itself remains unchanged but a few minor changes underneath this stage will be necessary. Consult the original schematic and then compare with the modified schematic. Included would be the resistors R608 and R609 to adjust the mixer plate voltage to the new recommended operating value. A 2.5 mh rf choke is added in the plate circuit and the 14 mc *if* output is fed to the added *if* amplifier stage through a short coax cable.

Now for the oscillator stage. This 955 acorn self-excited oscillator stage is changed into a push-pull tripler with energy at 139.3 mc being fed into the grids of a substituted 2C51 double triode push pull tube and tripling to 418 mc in its plate circuit. The 139.3 mc energy will be generated by a separate tube (6U8) enclosed in a small mini-box and fed

to the 2C51 by a short link. Details on this crystal-multiplier box shortly.

Back to the 2C51 tripler. The original invar tuning lines as used with the 955 tube were altered in this manner: Capacitor C617 is eliminated and the end of the lines at this point are joined by a loop of tinned wire, thereby shorting the lines at this point. At the tube end of the lines, the 2C51 tube is substituted without removing the original 955 socket. This is done by wiring a ceramic nine-pin socket with stiff bus-wire as short as possible and soldering these short leads directly on to the existing acorn socket—pins 4 and 5 of the new socket going to pins 2 and 3 of the existing socket. The heaters of the new tube are tied to the heater pins of the 955 tube. Likewise the cathode. The new added grid coil of the 2C51 is resonated at 139.3 mc with a small butterfly type capacitor and six turns of tinned wire. A two turn link couples the preceding crystal-multiplier chain to this 2C51 grid coil. The injection take-off point on the tuned line is left as is and the original coupling capacitor C43 is left in the circuit.

Crystal-oscillator-multiplier stage. Fig. 3 shows details of the 6U8 oscillator-tripler. Since 14 mc is used as the *if* frequency, the starting crystal is 46.444 mc. All the components are contained in a mini-box 4.5 x 2 x 1.5 inches. The photograph will show this box bolted on the side of the CFN-46ADT chassis. The 6U8 tube is bottled up inside this box and the crystal is left on the outside. An OB2 regulator may be seen. All components are described under the schematic. Be sure and use all the power lead filtering as shown and you will experience smooth operation with no spurious beats or birdies.

The 14 mc *if* Amplifier. Although not strictly necessary, due to the ample rf pre-amplification ahead of the triode mixer stage, it is desirable nevertheless, to include a 14 mc *if* amplifier to bring up the output of the mixer so as to work into just about any type receiver. A gain control is included in this stage to adjust the level to suit the receiver used. A type 6CB6 pentode is used. The rather low *if* of 14 mc allows one to use a tube of this type without excess noise being added to the circuit. The over-all noise figure of the converter is determined way ahead of this stage and unless regeneration is present in the 6CB6, its added noise is considerably below the operating level of the mixer and rf stages.

It can not be argued that 14 mc is the optimum *if* for 432 mc operation. It probably is not. 28 mc, 50 mc or perhaps even 144 mc

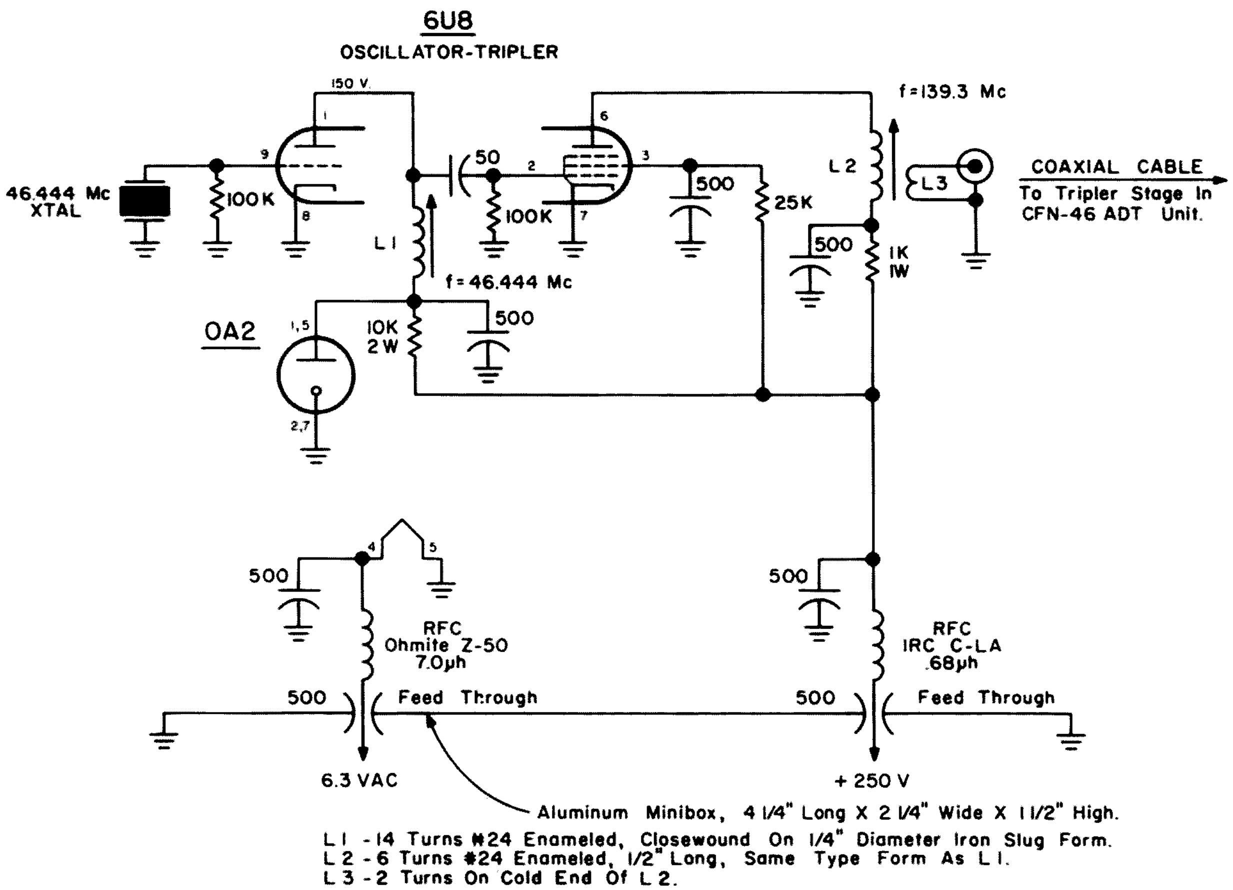


FIGURE 3

could be shown to be better on paper. However, other problems can be present, such as undesirable feed-thru from strong local 50 or 144 mc stations. This can be difficult to eliminate, especially if the 432 mc converter is fed into another high sensitivity 50 mc or 144 mc station converter, thence into the station receiver. The terrific gain an dthe various beats from the conversion oscillators may well nullify the higher *if* advantages. It also ties up the 50 or 144 mc station converter at the same time. With the 432 mc band rather uncrowded (to say the least) at this stage of the game, the lower 14 mc frequency was found to be cleaner and less troublesome by far. Actually there are no spurious beats or birdies in this receiving set up and no *if* feed-thru if the station receiver is reasonably tight in the antenna input section. If it is not tight, it would be wise to take time out and see if the feed-thru can be further eliminated either by shielding and/or filtering of power leads, etc.

Operation

A power supply capable of delivering 250 volts dc at 60 ma and 6.3vac at 3.5a will be necessary to power the converter. The instruction book on the 46ADT specifies a voltage of 180v at the plates of the two rf stages (V601-V602) and 160 volts at the plate of the mixer tube V603. After operating at these voltages for some time, we found that we could reduce this value to about 75 volts on each tube of the 2C40's without actually damaging the S/N ratio to any detectable extent. As a matter of fact, it appeared to actually help reduce the inherent noise of the unit, while the signal remained intact—and this is recommended to you to try. This is easy to do by bridging R601, R602, R604, R605, R608 and R609 with appropriate values of resistors for a trial. With the new voltages on the plates, the current drain will drop to about 4 or 5 ma per tube. Also for long life on the 2C40's it is perssible to reduce the heaters to 5.8v from 6.3v. Just add enough resistance wire from an old rheostat to the line feeding the 2C40 heaters. Tubes have been in use for two years without replacement under these conditions.

Tune up. Lacking expensive lab type equipment, the preferred method of tune-up for the average ham will be an out of town weak 432 mc signal. The run of the mill signal generator route will get you in the ballpark but the final tuning should be done with the dis-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tant *weak* signal. Do not use a strong in-town signal unless your antenna can null the response to a very low value. The best S/N ratio is found with a very weak signal. Tune each cathode and plate control (two on front panel and three on the rear side of the cavities) until the very best S/N ratio is obtained. You will find that these adjustments will stay put month after month and the unit will be very stable in every way. The selectivity of the coax cavity rf circuits will require retuning after excursions of a few hundred kc's but this is an advantage rather than a disadvantage under present conditions.

Further Suggestions

A word was said at the start of this article regarding the evaluation of the 2C40 tube in terms of later type tubes such as the 7077, 6299, 7768, 8058 and others. It is true the newer tubes will undoubtedly produce a lower noise figure, but the availability of all but the 8058's is rather limited to the general UHF man. The 8058 shows great promise at $13.25 and it is hoped the price of this tube will be further reduced by RCA.

To upgrade further this CPN-46ADT, the use of the W.E. 416B tube is recommended. This tube is still available in scrounge circles and remains a first rate tube at 432 mc. Under full ratings with air blowing on the seals, it is entirely possible to obtain noise figures in the order of 4 to 5 db. However, the life expectancy may not be quite as good as the amateur would like. Operated with lowered plate and heater voltages and less air, the life can be made long, and the operation is still quite good under such conditions—the N/F probably being of the order of 6-7 db. Might even be a bit better with some tubes.

The 416B is also peculiarly adapted to readily fit into the coax cathode cavity tank circuits of such a converter as this, and with reasonable modifications will definitely help your over-all 432 mc receiving capability.

Such modifications have been made on the 2 rf stages of the 46ADT at this station and were well worth the effort. This will be the subject of another article, and after you get the converter working with the original 2C40's, the undertaking of such a project is again recommended for your consideration.

As this article is being written in May 1963, the tube type 8058 is being given tests in this converter. W5QOA, who helped with the original modification using the 2C40's, has come up with a very nice adapter which will allow the 8058's to be plugged into the 46ADT in place of the now existing 416B's. Preliminary work with these new tubes seem to point to excellent results—although not enough experience with on the air comparisons between the 416B and the 8058 is available at this writing. It appears definite, however, that it is going to be a rather close race, from a practical point of view.

After this, the parametric technique will of course be the ultimate answer at 432 mc, but it may be pointed out that the above converter still will make an excellent unit for the parametric pre-amplifier to work into—since it is wise to provide the best you possibly can in the way of a converter before you tie on the parametric device. . . . W5AJC

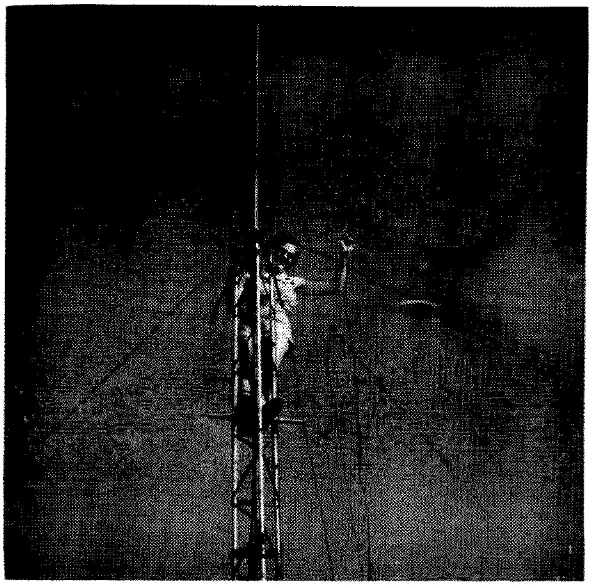
A Perfect Match

Doris Viney VE3DGV
Box 424
Kenora, Ont., Canada

So, you are going to marry an Amateur, and live happily ever after. All your friends and relations figure it's a perfect match (matrimonial wise, that is). Even Dad was won over when he heard that Bob was electronically minded enough to pass a code and theory exam, and obtain an amateur licence. "That's the type of fellow who would go far in this age of Telstar," Dad prophesied. Yes, I will agree, Bob would go far—but not quite the way Father predicted. Every ham goes far into the night, chasing those elusive dx stations; and far from home on field day, totally oblivious to any suggestions to the contrary his xyl might be making.

So, right from the start, if you want this match to get off on the right footing—and be equipoised, shall we say— first things must come first. And that means hamming has top priority, about 99.9%, to be explicit. Such ordinary things as meals, bedtimes, dentist appointments, meetings, company, holidays, etc. come under the .1% heading.

Never expect your ham husband to come at the first call for meals—or the second—or the third. Experience has taught, in the worst ham cases, to give the first call to dinner at the precise moment the roast is taken from the freezer. Then, once every hour, on the hour, as the dinner progresses—another call is given.



VE3DGV

By the time the roast is done to perfection, the Yorkshire puddings have popped, and the coffee is perking merrily, he will have a slight twinge of conscience at holding dinner up so long, and dash to the table on the double. This arrangement has kept peace in many ham homes every Sunday—no more frustrated wives, or dried-out Sunday dinners. Just one precaution here, though. Better keep some TV dinners on hand just in case *all* bands are dead when the sun spots are in their worst cycle.

And, while you are blithely shopping for your beautiful trousseau—a word of advice here. Buy plenty of outdoor clothing for every kind of inclement weather. That may seem odd, but that is just what you will be needing. Statistics show more antennas are broken, rebuilt, strung up, experimented with, shortened, lengthened, soldered, swr eliminated against, etc., in weather best suited to a good book, an old armchair, and crackling logs in an open fireplace.

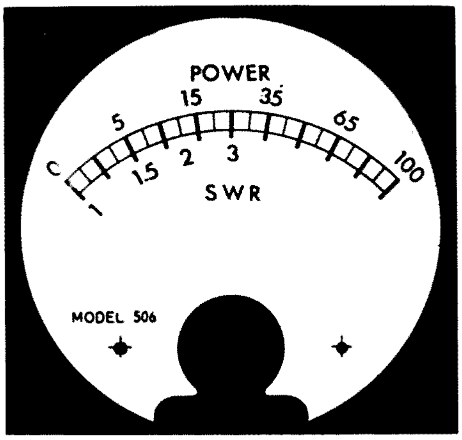
If there is a night school handy, quickly enroll in one of their classes that will give you a smattering of basic electronics, basic electricity, and basic engineering. You will need to know the names of the parts in the basic amateur receiver and transmitter—what each does and does not do.

A few practical lessons on working with a screwdriver, soldering iron, drill, chassis punch, etc., are excellent insurance against blisters, burns, and general frustration. Time will come when you are automatically expected to cope with such foreign aids as these. And remember, 4-40's and 6-32's just do not mix.

(Turn to page 104)

EASIER LIVING WITH SWR / PWR METERS

Mitchel Katz W2KPE
147-11 76th Avenue
Flushing 67, New York



Every so often in the various radio publications there appears an article about an SWR meter or an rf power meter. Such an article did appear in a recent issue of 73 Magazine. In practically all of these projects the use of a meter having a 0-1 scale is prescribed. The meter itself may have a 0-1 milliampere or perhaps a 0-100 microampere movement.

For the purpose of checking SWR a calibrated graph may be included with the article. More often, however, even this time saver is omitted and it becomes necessary to resort to mathematical computation in order to arrive at the answer. The usual formula that is included is: VSWR= F+R divided by F−R, where F is the forward meter reading (usually full scale) and R is the reflected power reading on the meter scale. More about this later. As an assist to those using SWR meters, an SWR/PWR meter scale is being featured with this article in order to eliminate the annoying math. If this scale is cut out and handled with care it may be pasted to the back of the original meter scale to facilitate making measurements. Although this scale has been made up for a Weston model 506 meter, it should work with meters of other manufacturers as well. Using this scale it would no longer be necessary to use a 0-1 milliampere or 0-100 microampere meter. Almost any meter having sufficient sensitivity to give a full scale Forward reading with your transmitter could be used.

Now about the scales. First the meter arc itself is broken down into 10 heavy markers. This would represent a basic scale of 0-100 with each of the heavy lines indicating 10. Between each of these lines there is another line representing 5. Above the arc we find the POWER calibration indicating from 0-100. If your directional coupler is of the wattmeter type such as used by Collins, you can calibrate full scale of the meter to indicate either 100 or 1000 watts. This being the case, you would be able to read any change in transmitted power directly from the meter. Any of the usual methods could be used to calibrate your unit, such as an rf ammeter in series with a dummy load, or perhaps a calibrated VTVM with an rf probe across the dummy. If your directional coupler is of the type used to measure VSWR such as the Heath, Johnson etc., then you would merely adjust the sensitivity control for full scale meter deflection in the forward mode, and this would be your forward reference level only. The calibration of the power scale follows the "square law" principle. If for a given power the meter is adjusted to read full scale or 100, it would be necessary to reduce the power to twenty-five percent of this value for the meter to drop to half scale. This is what is meant by the "square law." There are some meters on the market that feature a linear % Reflected Power scale. Actually these meters merely indicate the percent of the full meter deflection and not the true percentage of the reflected power.

Below the arc is the SWR scale. A reflected power of 4% would also be an SWR of 1.5:1. If the reflected power is 11% of the forward power then the SWR is 2:1 and a reflected power of 25% would represent an SWR of 3:1. As standing wave ratios above 3:1 represent excessive losses, they were not included on the meter scale.

In drawing up the scale some liberties were taken in the interest of simplification. At the low end of the power calibration there will be a small error, but the accuracy increases rapidly as we approach full scale.[1]

If you are trying to measure standing wave ratios greater than 3:1, or want a reading between those on the meter scale, then it would be necessary for you to resort to math to get your answer. Earlier in the article the formula was given as: VSWR= F+R divided by F−R. Now let us try an example using this formula. First tune up the transmitter into its dummy load or into the antenna itself. With the directional coupler switched to indicate forward

power we adjust the sensitivity control for full scale on the meter. Call this 100. Now throw the switch to indicate Reflected power. Suppose in this mode the meter reads to the second heavy line, which would represent 20. Using the VSWR formula we get 100+20 divided by 100−20 or 120/80. This gives us our answer of 1.5 or 1.5:1 SWR. This particular value, however, would not require calculation as it is indicated directly on the meter scale! SWR can also be calculated directly on a power basis if you are using a calibrated wattmeter type of coupler. For this method our formula becomes: SWR using power in watts $= \sqrt{F/R} + 1$ divided by $\sqrt{F/R} - 1$. As an example of this method suppose our forward power is 100 watts and our reflected power is 25 watts. Using the power formula just presented we get $1+\sqrt{100/25}$ divided by $1-\sqrt{100/25}$. This answer comes out to 3 for an SWR of 3:1. Either method can be used equally as well, although the previous method using meter scale calibration markings might be easier to handle.

It is hoped that the published meter scale along with this article will help make life easier for those that cared to read.

. . . W2KPE

Institute Museum

If you have any ham gear circa the mid or early thirties please make arrangements so it won't be junked when you leave us. We'd sure like to have it for display in the museum here with your QSL on it.

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and
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All Band Conical Antenna

Would you like to get away from your "antenna farm" with a separate antenna for each band, and operate on all frequencies from 80 meters through 10 meters with one antenna that will load flat with a 1:1 SWR all the way across each band?

The accompanying diagrams depict such an antenna. Dubbed the "All-Band Conical," and derived from the driven elements of a broad-banded television conical antenna, this antenna will allow operation on all amateur bands from 80 through 10 meters with maximum transmitter efficiency and vastly improved receiver reception.

The antenna system consists of two horizontal vees, back to back, center-fed with 450-ohm open-wire feed line, tied to an antenna coupler of the Johnson Matchbox type. Vertical arrangement may be either of the flat-top type, inverted-vee design, or just about any other configuration to fit your individual requirements, so long as it remains balanced on each side. The horizontal vees, with a 20° to 30° angle between each leg, cause the antenna to have very broad tuning characteristics, thus permitting large frequency excursions up or down the band from the resonant tuning point with resultant low increases in SWR.

All-band operation is accomplished by use of a Johnson Matchbox or similar parallel-feed antenna coupler. This provides a method of tuning the feed line to whichever band is desired and converting your unbalanced transmitter output to the balanced input of the conical feed system.

Maximum transmitter efficiency results with such a system because the matching coupler will present a near perfect resistive load to the transmitter on all bands. Problems of transmitter heating due to absorption of reflected power are eliminated; if you are troubled with your transmitter making like a "hotbox" with high SWR, this is the way to cool it off!

This antenna has been loaded from the low end of 80 meters through the high end of 10 meters with exceptionally good results throughout. The authors, operating a Viking II on AM and a Tri-Band Swan (home-brew conversion; both sidebands, too!) can load up on any band with a 1:1 SWR and can then move as much as 50 kc in frequency without affecting the SWR and transmitter loading enough to necessitate a change in any adjustments.

When transmitting on a coax-fed dipole or inverted vee cut for the center frequency of any single band, it is noted that movement up or down frequency from the antenna's resonant point introduces either inductive or capacitative reactance, with corresponding increase or decrease in plate current loading, and a rise in SWR. If a large frequency move is made, the final must be re-dipped, and sometimes more or less capacitance must be introduced or removed in the final tank loading circuit in order to maintain the required power level.

Not so, however, with the conical antenna; after loading the transmitter on any band and adjustment of the antenna coupler for a 1:1 SWR, movement to any other frequency within the band necessitates only minor antenna tuner adjustments to return to a 1:1 SWR at the new frequency. When this adjustment has been made, the transmitter again sees the same resistive load as previously, and transmitter loading will remain at the same point as before moving in frequency; only slight final tuning or re-dipping is required. This is indeed a bonus factor for those amateurs operating one of the fixed impedance output transmitters.

The development of the conical antenna resulted from the search for a broad-band radiator which would present a minimum physical mismatch to the feed line. The conical antenna arrangement approaches the ideal configuration to reduce this physical mismatch. The transmission line and antenna surfaces are smoothly

tapered so the transmitted wave energy actually sees a metallic funnel. As the energy travels up the feed line, it will be smoothly squeezed out into the antenna while encountering a minimum change in direction of flow. Large-diameter antennas are very desirable in amateur operations, because they present very broad-banded characteristics, but a large-diameter transmission line (to avoid the undesirable physical mismatch) is not very practical. Thus a really thick antenna may prove to be less desirable than moderately thick ones unless some method of special shaping is employed to smoothly increase the cross-section of the practical transmission line to match that of the large-diameter antenna. The conical antenna herein described provides a method of making such a transition, and greatly reduces stray capacitance from such a mismatch at the antenna feed-point.

In addition, the progressive increase in cross-section from the center feed-point to the outer ends of the antenna tends to keep the surge impedance constant at each successive section of the antenna. A constant cross-section antenna such as the center-fed dipole or the inverted Vee exhibits successively higher surge impedance from the center feed-point to a point near the ends, where the surge impedance suddenly falls to a very low value.

Variations in the all band conical antenna's design are limited only by the number of individual ideas. The angles associated with the conical and the number of elements employed, from two to a solid conductor, or cone, have an infinite number of combinations, each with a small change in operating characteristics. The antennas of this design constructed thus far locally have consisted of only two legs or elements on each side of center. This is only the outline of a true conical, but the addition of two *more* elements or legs on each side would only reduce the Z/R ratio by less than 1/3 of the ratio of the two-element conical. The two-element conical reduces the Z/R ratio by more than ½ of the ratio of a single-wire doublet. The optimum ratio of Z/R is, of course, one to one. If the Z/R ratio of various antennas is examined, its importance will be realized.

Most single-wire inverted Vees have an angle of inclination from the horizontal ranging from 20° to about 45°. The Z/R ratio will be from 14:1 to 19:1, depending on the size of the wire conductor. The two-element double-vee conical can be constructed with any cone angle from 1° to 90°; the normal angle will be from 10° to 60°, with the optimum cone angle being around 30°. The Z/R ratio at this angle will be about 8½:1. With four elements

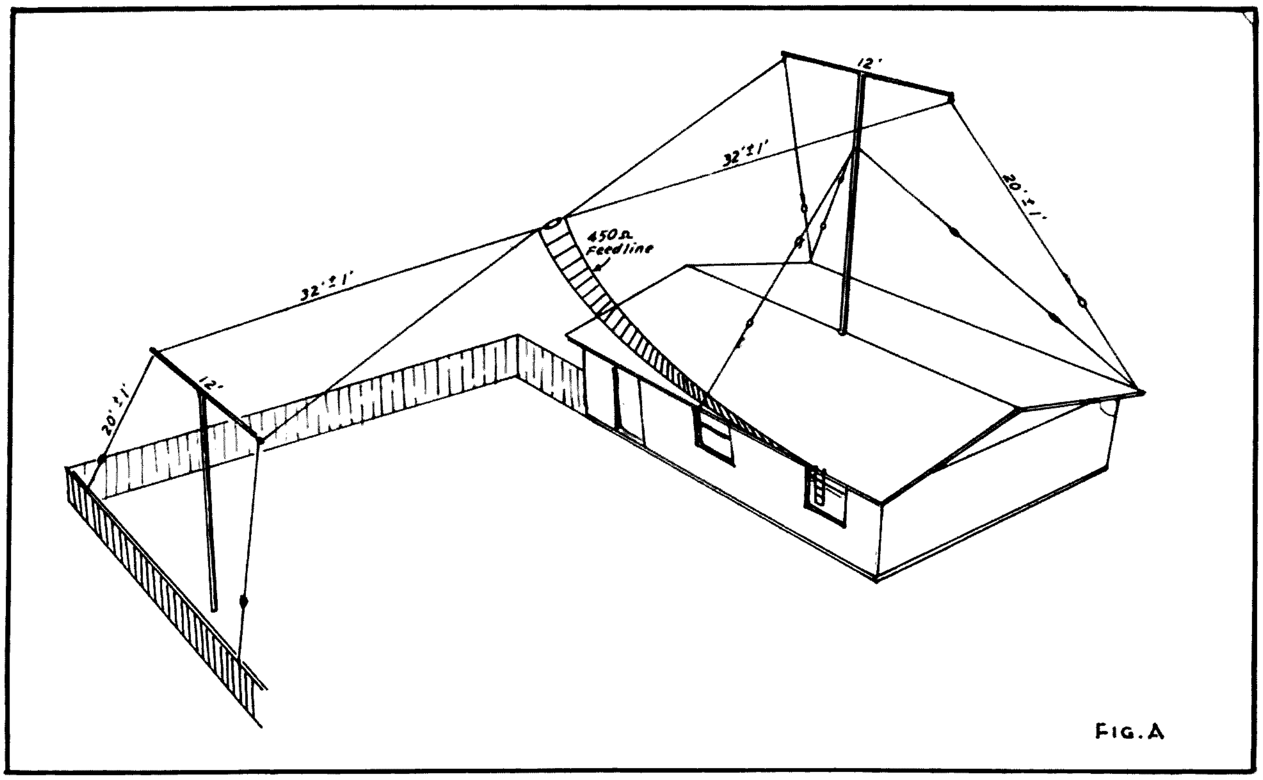


FIG. A

Fig. A—The installation at W5VOH. The spreaders are made of one inch conduit with a one inch dowel driven inside the conduit and protruding a foot on each end. A pulley on the mast makes it possible to raise and lower the spreaders. Both masts are of the TV telescoping variety.

forming each cone on each side of the center feed-point and the same optimum cone angle of 30°, the Z/R ratio is only reduced to about 6½:1. It is important to note that when Z/R is at a minimum, the ratio of R_{max} to R_{min} is also at a minimum.

Another factor to note is the load resistance, which varies with the cone angle. As the cone angle is increased, the impedance of the antenna decreases. Again the optimum cone angle is about 30°; at this point the center feed-point impedance is about 350 to 450 ohms. This impedance is also related to height above electrical ground; you should strive to elevate the center feed-point a quarter-wave or more above electrical ground at the lowest operating frequency.

Still another aspect of the conical which will be appreciated by those who are limited in space in which to erect an amateur antenna is the fact that as the cone angle is increased, the electrical antenna length is increased. At the recommended cone angle of 30°, the electrical length will be approximately 75% of the calculated length required for a single wire. Ninety feet will resonate at 3900 kcs. However, it is recommended that an overall length of 105 feet be utilized if at all practicable from an erection standpoint.

Additional efficiency is obtained by use of 450-ohm open-wire feed line and the method of feeding the antenna. RG-58/V coax, in popular usage for center-feeding inverted vees and half-wave dipoles, has an attenuation factor of approximately 2 db per 100 feet at 30 mcs, and the attenuation factor for RG-8/V is around 1 db per 100 feet. However, the attenuation factor of 450-ohm open-wire line is only 0.15 db per 100 feet at the amateur frequency mentioned. When it is considered that a doubling of transmitter power will result in only a 3 db signal increase, it can readily be seen that use of open-wire feed line as compared to use of coax results in quite a gain.

Added efficiency will also be noted at the receiver when this antenna is used as a receiving antenna. Consider a center-fed half-wave dipole, fed with coax transmission line, and cut for the center of the 40 meter phone band. The center conductor of the coax is connected to only one-half of the antenna, with the other half acting as a grounded counterpoise, so any signal to the receiver is obtained by the E.M.F. generated in 32′ 3″ of antenna. (The coax won't pick up any signal, either; it's shielded.) The conical antenna will provide around 300 to 400 feet of receiver antenna wire for generation of an E.M.F. at the receiver's terminals, depending on the length of the open-wire feed line (it is a part of the antenna and picks up signals also). Thus there is more wire available in the antenna for receiving and the signal

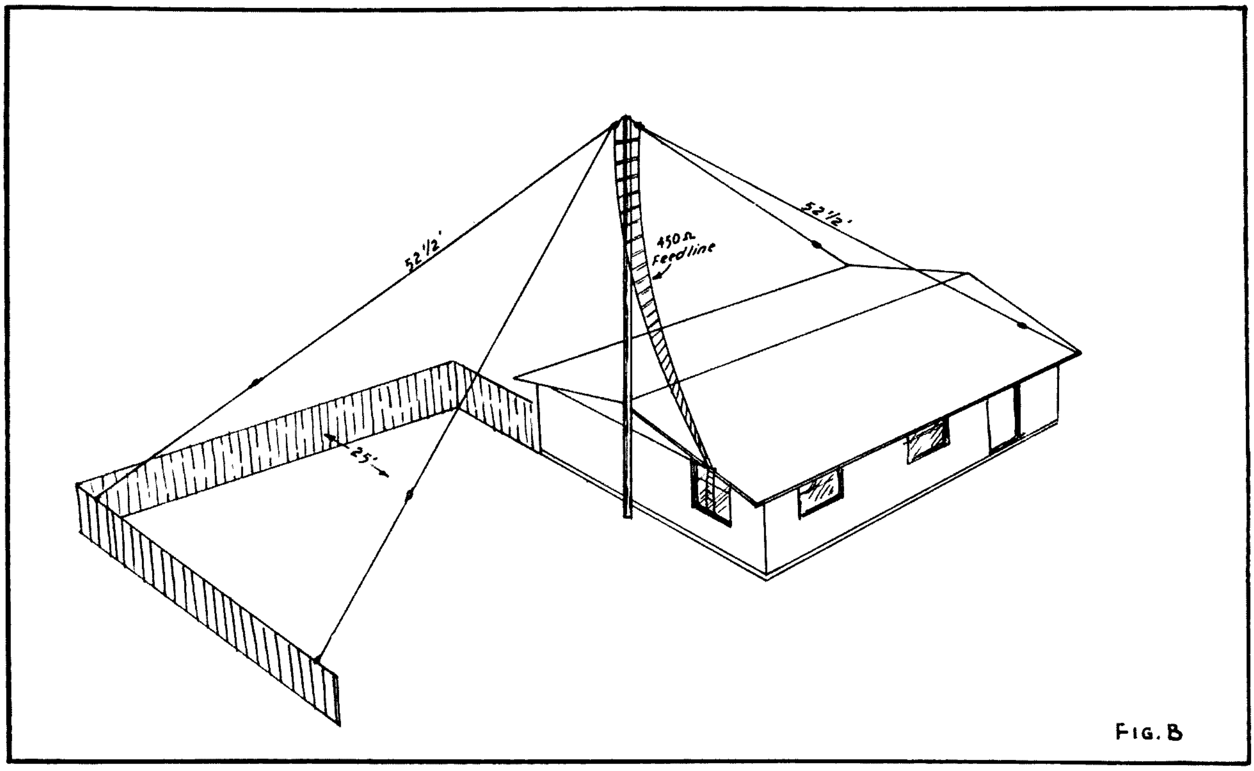


Fig. B—The installation at WA5DEL. Refer to article for descritption of insulator delta constructed at the center. The inside angle of the two sides should be larger than ninety degrees.

heard will be stronger.

Still a further advantage to this antenna will be realized by use of the antenna coupler. Since the antenna coupler's use results in the addition of another tuned circuit, further and better elimination and suppression of harmonics is obtained. And, if this is not enough, the system lends itself well to insertion of a low-pass filter in the transmission line between the transmitter and the antenna coupler for further reduction of harmonics above 30 mc if desired (TVI you know).

The directivity pattern, if any, of this antenna has not been determined by the authors. No doubt, it does possess major and minor lobes which probably shift with band changes, but it is thought that very little difference in signal strength exists between the major and minor lobes. The authors have worked with full-circle coverage on all bands with very little attenuation in signal strength reports from any direction. It should not be any more directive than the ordinary garden variety of center-fed dipole or inverted Vee, and, when the band is in, you can talk with it wherever the signals may be coming from.

An antenna length of 105 feet is recommended, with each leg of each horizontal vee being 52½ feet in length. No. 12 or no. 14 wire would probably work very satisfactorily, but the authors recommend use of no. 10 soft-drawn copper wire for the antenna, because of both the larger cross-sectional area and the added structural strength obtained. Don't worry about soft-drawn copper's stretch in hot weather; the antenna coupler will take care of changes in length due to temperature changes. Thus still another advantage is realized from the conical antenna system because you get away from the changes in antenna resonance which occur on a single-band coax-fed dipole when it is lengthened due to temperature changes or physical sag.

The 450-ohm open-wire feed line used by the authors is formed from no. 18 wire, with 1" polystyrene spacers every six inches or so, and is the commercial TV variety which is readily available for approximately 2c per foot from most radio supply houses (Lafayette, Burstein-Applebee, etc.). This size feed line should safely handle powers up to 400 watts or so on AM and a KW on side band. Remember that $P = I^2R$. Assuming a power of 1000 watts on the 450 ohm transmission time we have $I^2 = 1000/450 = 2.222$ or $I = 1.5$ amps. In an open air installation, such as a feed line, the no. 18 conductor will handle more than

(More radiate on 38)

(Antenna from page 35)
twice this current with ease. If you are going to run a full gallon on AM you may wish to construct your own feed line from no. 12 or no. 14 wire. In this case, spacing between each side of the feed line is dependent upon the diameter of the wire used, and can be calculated for an impedance of 450 ohms by the formula for the impedance of air-insulated parallel-conductor transmission line, which is:

$$Z_0 = 276 \log \frac{b}{a}$$

when "b" is the center-to-center distance between conductors and "a" is the radius of the conductor. If you do construct your own, we suggest that you purchase ¼" diameter polystyrene rods, cut them up into lengths required for the spacers, and drill the wire holes just large enough to pass the wire through. A hot soldering iron judiciously applied will then seal each spacer hole around the wire and you've got your feed line made with a minimum of effort.

The feed line length is apparently not critical; one of the authors uses a length of 40 feet, the other uses 95 feet, while still a third local amateur installation uses 60 feet, and results at all three stations have been very good. If, after erection, trouble is experienced in loading on any band, try experimentally adding ⅛ to ¼ wave length or so at a time to the feed line until you arrive at a length where good loading characteristics are obtained. If you have trouble at all in loading, it will probably be on the higher frequencies, and if you can arrive at a feed line length which works satisfactorily on 10 and 15 meters, it will work well on the lower bands.

A word of caution: the open-wire feed line is hot with rf when transmitting, and must be insulated from contact with any conducting surface. Provision must be made for use of feed-through and stand-off insulators for passing the feed line through windows, etc., and at roof eaves. The authors utilize old-fashioned porcelain knob-and-tube insulators, such as were in prevalent use years ago by electricians for open-wire house wiring before the advent of romex house wiring. In case you have trouble locating this item at the radio supply house, try Sears Roebuck; they were obtained for 5c each here in Texas.

A method of getting through a window of the shack to the outside without drilling holes in the window itself requires a piece of masonite board cut to your window width and about 6" high; raise the bottom window sash and use the masonite as a spacer, and the top of the masonite will fit into the weather-stripping groove on the under side of the window sash, affording a weather-tight closure. The feed line is passed through feed-through insulators in the masonite and in the outer window screen wood frame.

The authors found that the porcelain knob insulators mentioned above had a high-resistance leakage to ground when wet from rain. Resistance to ground, reading infinity when dry, was found to be 700 K ohms when wet, but this defect was easily remedied by wrapping the open-wire feeders at the contact points with the insulators with plastic electrical tape and no further trouble was experienced due to leakage to ground.

A support for the antenna center feed point, and a convenient method of hanging the antenna to your mast, can be devised by forming a delta from three strain insulators about three inches in length, readily obtainable from your radio parts house. Attach each vee to one of the two bottom points and hang the whole antenna to your mast or pulley by the top point.

If difficulty is experienced in obtaining a 1:1 SWR after installation, examine the antenna to determine if a metal wire guy line or any other metal conductor might be within the field of one of the horizontal vees, thus unbalancing it with respect to the other vee. The conical is a *balanced* antenna, and metal within the field of one of the sides will cause unbalance and consequently you cannot get the SWR down to 1:1. This trouble in the installation of one of the authors' antennas, was caused by a top tower metal guy line within the field of one vee; it was remedied by replacement of the metal wire guy line with a nylon rope guy line. Another possibility that may result in an unbalance can be caused by bringing off the feed line too close to one side of the antenna. The feed line should be brought off from the plane of the antenna as close to 90° as is practicable. The angle does not have to be at exactly right angles, but an angle smaller than 60° may cause an unbalance due to coupling.

The conical antenna is a simple antenna to construct and erect. The accompanying diagrams depict the arrangements used by the authors, and you may improvise any arrangement required to suit your space requirements, so long as you keep it balanced. If you will utilize a little care in making good electrical connections and in insulating the feed line, it will put a signal on the airways that you can

be proud of. One word of caution is in order: Since the conical presents such a good load and pulls all the rf available from the transmitter, the authors have found it necessary to bolt their transmitters to the operating table to prevent them from being pulled up the feed line and lost in outer space.

. . . W5VOH . . . WA5DEL

Single Diode Frequency Double

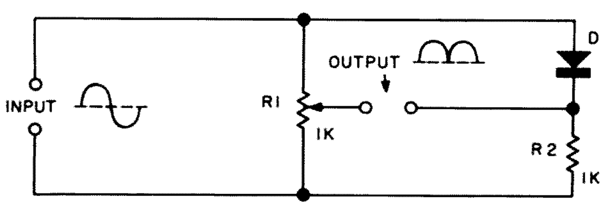
Rufus Turner K6A1

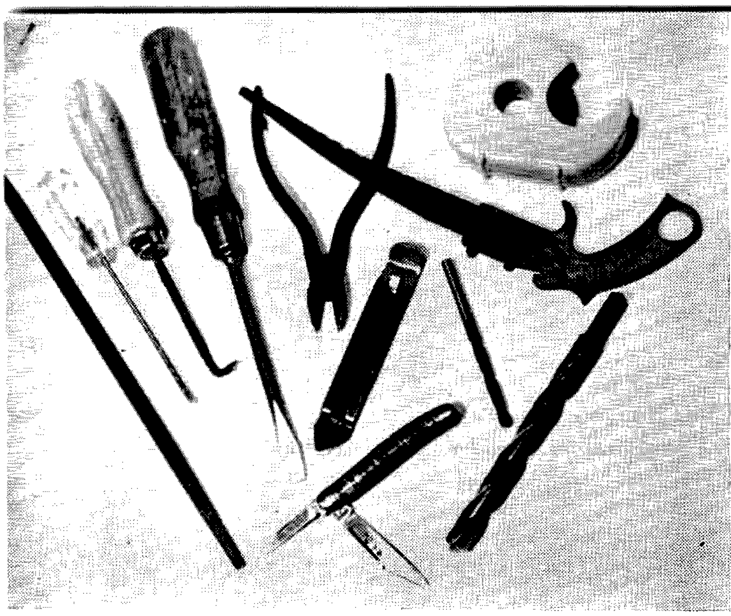
The output ripple of a full-wave rectifier is an easily obtained double-frequency voltage for synchronization, timing, tone generation, frequency doubling without amplifiers, etc. Four diodes (or two diodes plus two resistors) generally are used in a bridge circuit, since this is more economical and less frequency dependent than the transformer-coupled full-wave rectifier. Further economy is provided by the circuit shown in Fig. 1; this is the less well known single-diode rectifier bridge.

To balance the circuit initially, apply the input ac voltage, connect an oscilloscope to the output terminals, and adjust R_1 for equal height of the output-signal humps. No readjustment is needed unless the diode is replaced.

This circuit has the advantage that it will work with any kind of diode and is not frequency selective (the frequency range of the diode itself determines the circuit range). Operation thus is provided from the lowest audio to ultra-high frequencies. Nor does it discriminate against most waveforms. Its disadvantages are the few common to such bridge rectifiers: lack of a common (ground) connection between input and output, and signal attenuation due to voltage divider action of the bridge.

. . .K6A1





Tool and Workshop Practices for the Ham

SPECIAL SECTION

Fred Haines W2RWJ
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Liverpool, New York

If your tool box is at all like mine, it is most difficult to explain, and further, it doesn't even faintly resemble the surgically precise list of required tools in the ARRL Handbook, chapter on Construction Practices. What a dreamer the fellow who complied that list must have been!

Among the "indispensable" tools is listed an item (I believe they are used in tool rooms) called a center punch. A friend of mine told me yesterday they are used to mark the place where a hole is to be drilled. Ever since the advent of the aluminum chassis, the center punch has not been common in ham workshops. Why? What homebrewer worthy of the name would give up the skill required to start a ¼-inch hole in a chassis without a center punch? My method is to place the drill point about ⅛-inch from where the hole should be and then start the motor. With years of experience, the drill will "walk" right up to the pencil mark and stop. At this point a little pressure from the op, and the chips are flying. For mounting high-precision components, always use a large drill about twice the size of the required hole. This insures that the part can then be positioned to come out parallel to the edge of the chassis or panel. The author uses large flat washers under the screw heads if they have a tendency to fall through the drilled holes.

Some day I'm going to buy a real wire stripper. In the meantime, my old jack-knife does a pretty good job. You know the knife I have in mind. I inherited mine from my Grandfather, who used it for cutting dandelion greens each spring for many years. My Grandmother told me he also sometimes used it for scaling fish, but not too often. I wouldn't be able to start a construction project without that fool knife. Once I lost it for a time and almost gave up ham radio! Why, I remember the first piece of wire I stripped with that heirloom. It was to run a wire from the gridleak resistor to the grid of a type 24-A tube. Anybody remember those? The blade (I'm back to the knife now) is so nicked up and rusty that it wouldn't slice limburger cheese, but boy, you can really bear down and strip wire with it. It takes years and years to condition a knife for this use, but it's worth it. The only drawback to having one around is if you lose it it's an emotional shock. By the way, I've never found a better tool for scraping the oxide off a soldering iron tip.

As far as drills are concerned, I broke most of mine a long time ago. God bless the aluminum chassis again! Because of these new chissis I never have replaced all those broken drills. I priced a set of new ones in 1953 and boy, are they expensive! My Grandfather's tool chest had a rat-tailed file in it too. Now I have one small drill (about ¼-inch) and one large drill (about ⅜-inch), and use the rat-tailed file for gnawing out anything in between! For really small holes, finishing nails are tapped through the chassis with the old mallet.

Screwdrivers are rather critical too. With my limited budget, two screwdrivers must do for all occasions. Since the Phillips head is coming into its own, this is quite a trick. The way it's

done is to grind down the blades on two flat-bladed drivers (one large—one small) so the blades will mate with one axis of the Phillips head. This has a tendency to chew up the heads a bit, but ham radio is after all only a hobby, and as I grow older I find that nothing is perfect anyway, so why struggle?

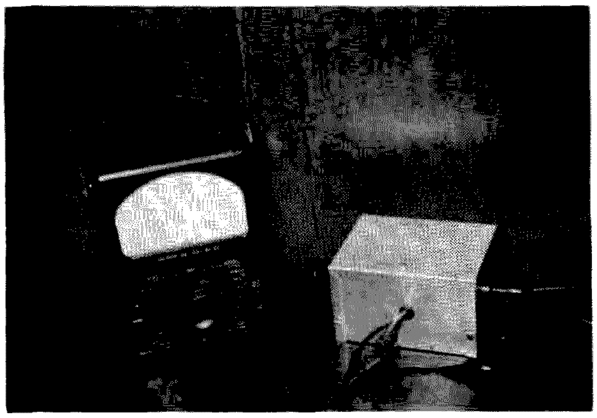
My hacksaw is circa 1925 with an old grease-soaked wooden handle. I think my father used it for years out in the garage where it had several run-ins with motor oil. It was probably a good thing because how else could a blade last all these years without getting too rusty? In case you didn't know, there's an advantage to a blade this old! Have you ever noticed it's difficult to start a hacksaw cut without the blade jumping and scarring up the work? That's because the blade is too sharp! With an old blade the teeth in the middle are about worn off and this allows a start to be made easily. After the cut is started, it's a simple matter to move the saw forward and cut with one end of the blade which still has teeth. I hope the beginners among us are taking heed so they won't be taken in by zealous salesman at the hardware store. New tools aren't always the best tools!

The best scriber for marking lines on chassis is an old ice pick I saved from the 1930's. Remember the cards we used to put up in the window to tell the ice man how much ice to bring in that week?

Long-nose pliers would be nice, but it is felt they are definitely a luxury. The author has for 20 years been successful in using a pair of diagonal cutters as a dual-purpose tool. Anything you can do with the long-noses, I can do with the cutters! In fact, I can save time this way. Admittedly, it takes practice to bend a wire around a terminal with the cutters without nicking the wire. But once the skill is gained, think how handy it is to bend the wire around the termnal and then cut off the surplus without having to set down the cutters and pick up the long-noses. Lost time and motion!

I have described the tools used most often in my tool box. They are all that stand between me and commercial equipment. I hope this has been an inspiration to those who hesitate to become homebrewers because they have been misinformed about the cost of equipping a home workshop.

. . . W2RWJ



Jack Myers W5KKB
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Baton Rouge 8, Louisiana

A Simple AC Adaptor

This article describes an ac current adapter that will convert any VOM or VTVM to an ac ammeter. With all parts purchased new it should cost less than $10, but if you have an old soldering gun that you wanted to replace anyway, the cost will be only a couple of dollars. Basically the circuit consists of a soldering gun transformer used as a current transformer with a load resistance chosen for accurate calibration. For utmost ease of reading, this resistor is chosen so that 1 volt output represents 1 ampere input, eliminating the need for any conversion factors or tables.

Safety is assured by the complete isolation of the input and output circuits and by the relatively low voltage output. With the design shown, provision is made for in-the-line or test-lead current measurements. The effective input resistance is only 0.01 ohm, which gives a voltage drop of only 0.15 volt at 15 amperes.

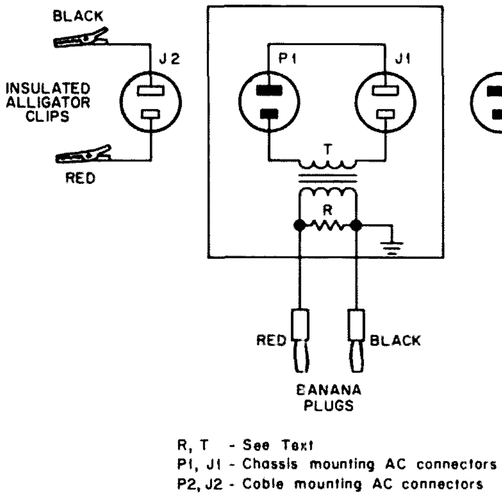
The Transformer

The transformer used by the author was taken from an old Weller S-400 soldering gun that had finally given up the ghost. It is necessary that the primary winding (the 115-volt winding) be in good shape since this winding is used as the secondary of the new transformer. The secondary of the solderin gun was copper tubing which must be removed. This was accomplished by cutting off the tubing close to both ends of the transformer core and then using a screwdriver and hammer to drive out the remaining tubing, being careful not to damage the core or 115 volt winding.

The old tubing was replaced by 3½ turns of no. 18 test lead wire, which fit very nicely. The completed transformer was then wrapped with a few turns of cardboard for insulation and clamped to the bottom of a 3" x 4" x 5" aluminum box with a U-clamp fashioned from some thin aluminum stock. The transformer leads previously used for the lights were not needed and were clipped off very short to keep them out of the way.

Calibration

Calibration is accomplished by connecting the adapter to a meter and a load which is drawing a known current and adjusting the load resistor, R, for the correct meter reading. This may be accomplished by either using a pot for R or by selecting a fixed resistor that gives a sufficiently accurate reading. *When making this adjustment it is imperative that there be a load resistor connected at all times*



SCHEMATIC FOR THE AC CURRENT ADAPTER
FIGURE 1

that current is applied to the adapter. If current is flowing in the primary and the load resistance is opened, extremely high output voltage will result which will probably damage the meter and cause a serious shock hazard.

To calculate the value for R, the turns ratio of the transformer must be known. In the case of the transformer used by the author, the secondary has about 350 turns. Since the primary was wound with 3.5 turns, the ratio is 350/3.5 = 100. The maximum current which can be measured is set by the ac connectors, which are rated for 15 amperes. At this current the secondary current will be 15/100 = 0.15 amperes and, for correct calibration, the secondary voltage will be 15 volts. Thus the secondary resistance must be 15/0.15 = 100 ohms at a power of 15x0.15 = 2.25 watts. This calculation does not account for any losses in the transformer, so the actual resistance needed may vary slightly from that indicated. The resistance of the meter will be negligible compared to 100 ohms for most VOM's and for all VTVM's.

Just to show what would happen in the event the resistance opened up or was removed, suppose the primary current were 15 amperes and a 5,000 ohms/volt VOM was being used. The meter would normally read 15 volts. If the resistor opened up the secondary resistance would be that of the VOM, namely 5,000x15 = 25,000 ohms. The secondary current would be 15/100 = 0.15 amperes, giving a secondary voltage of 0.15x25,000 = 3,750 volts. Of course transformer losses and saturation would prevent this much voltage output, but it does show why the resistance should not be opened. It might be good insurance to use two resistors in parallel for R.

Operation

The connector and cable system shown makes it easy to measure the current of any 115-volt device by plugging it into J1 and plugging P1 into an extension cord. In some cases it may be desirable to have regular test leads with clips; for example, when measuring filament current. In this case the clip leads are plugged into P1 and a shorted plug into J1.

There are numerous uses for the adapter. It can be used to measure actual current to a device so that the proper fuse can be selected. If the proper current for a device is known, the actual current may indicate whether improper operation is caused by a short or an open.

To facilitate power measurements, a dp dt switch may be added to switch the meter across the ac line for easy measurement of the voltage. If direct power reading is desired, a load resistance corresponding to the line voltage being used can be substituted for R. For a 115-volt line the resistance should be 1.15xR, for 120-volts, 1.20xR. Under these conditions the meter will read directly in hundreds of watts. A 50-ohm, 1-watt, resistor in series with a 100-ohm, 2-watt, pot would provide power readings for normal line voltages. A scale can be calibrated to common voltages with a special mark for the ac current position (the 100-volt position).

In conclusion, the author would like to express his thanks to Brooks Page K5LRQ for his assistance in testing and calibration of the adapter.

. . . W5KKB

Having trouble pulling cables through the attic or cellar? Do you dread going up in that boiling hot attic, crawling on your belly in dirt and soot? Eliminate all that with a come-a-long. A must in some shacks . . .

Earl Spencer K4FQU
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Ft. Myers, Fla.

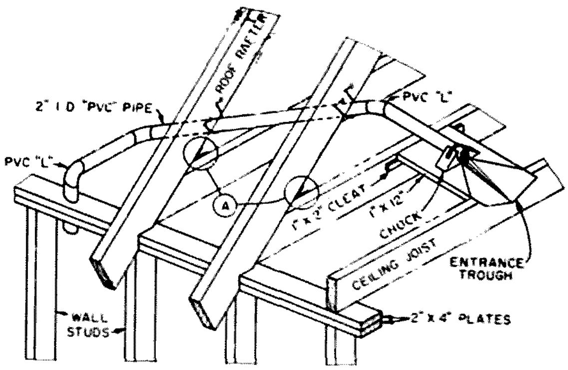
Come – a – Longs

The recent erection of a 75' tower created an uproar from the XYL that was probably heard up thar in yankee land. The reason is that the tower is in the shape of a monstrous class A transmission pole rising some 63' out of the ground just four feet from the corner of our rambling Florida ranch house. To her the tower represents an ugly wooden pole, slightly crooked, which was planted right where a royal palm should have gone, not to mention the fact that the complete setup towers some 60 odd feet above the roof of the house in a neighborhood where the highest structure was built by mother nature and grows a mere thirty feet. I haven't heard from the neighbors yet although I have felt the temperature drop

when I drive by. I wonder why the XYL's have such a warped sense of beauty. The gang thinks it's the living end, however this is another story so we shall go on from here.

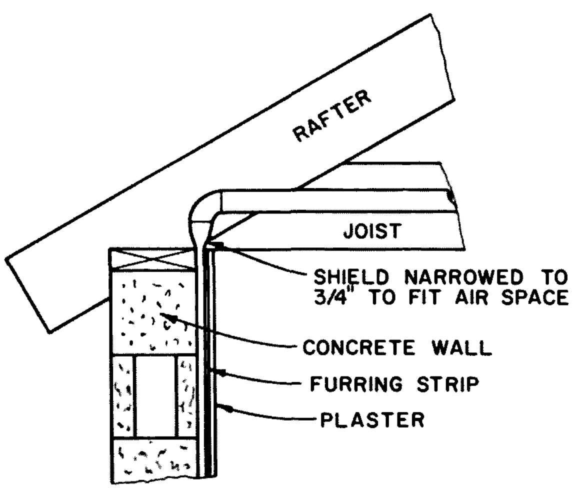
Needless to say, all antennas need feed lines and the best way is the shortest and straightest way which would have been right across our white tile roof some 50 ft to the shack and then draped somehow down the front wall of the house to the entrance point of the shack. I can hear everyone saying what's wrong with going that way but I could also hear the XYL exploding again, so rather than risk running the gamut with the wife again I did a bit of thinking (which was the hardest part) to find another way.

I thought of running around the eave of the house but this would have added some 40 ft of coax cable to the feed line that was already over 100 ft long so this way was out. I had to find a shorter route and that left only one way to go; through the attic, and I say the word attic without trying to laugh. That's what they call the space inside the roof here in sun land. It is actually just a hot dark and very dirty crawl space which is scarcely 24" high at the highest point right under the ridge, through which no man should have to crawl or wiggle some 50 ft. and back over ceiling joist more than once. To make matters worse the entrance to this fabulous place is always in the center of the house in the hallway or worse yet in a closet, which means emptying the closet to gain access to the hole in the ceiling. Either way again crosses the XYL's little temper who just can't stand her clothes (it's always *her* closet) dumped on the bed or floor not to mention all that dirty wire in the livingroom along with stepladders, dirt, etc. I have come to the conclusion that the more we stay out of our wives houses the better off we will be. So if you are in this fix and have decided to build a come-a-long the first step is to install a



new entrance to the upstairs dungeon, preferably out of doors. I cut one in the carport ceiling right under the ridge and big enough to get through without going on a diet, so some of my problems were solved. I still had to get the lines down the walls to the shack and this is a problem, as the only wall I would enter was an outside wall which has virtually no space over it in the attic due to the rafters resting on the wall. I had to go into this wall and so I continued on my merry way by attempting to cut a hole through the plates at the top of the wall. I finally managed it by using an electric drill fastened to a four ft board with a right angle chuck in the drill and a 2⅛" circle cutter. It took some time but the hole was drilled eventually.

To give explanation to such an elaborate setup just to run a few feedlines, I can only say that the drawings will speak for themselves and give reasons for the need. Note in the drawing the points marked "A." At this point the roof rafter passes the ceiling joist forming a sharp V which invariably hangs on to anything that is pulled by it on its way out. I fought this particular point through three feed lines and finally vowed that I would go



ALTERNATE FOR MASONRY WALL

up in the hole just once more, which is what finally led to the Come-a-long.

After much thought and a couple of 807's I found an answer which has been a blessing ever since. Who else can run 75 feet of RG-8 through a gable end, over 50 feet of open ceiling joists, down through a wall and into the shack in five minutes all by himself? I can, now, and so can you after building yourself a Come-a-long!

In the installation of one there are a few points to avoid or you can be in as much trouble as when you started. This piping is a commonly used material called PVC. It is plastic, usually black in color and rather hard in texture although quite soft to cut. A pocket knife or hacksaw will do a good job. It is recommended that the pipe be joined with a special glue made for PVC, however pipe clamps can be used instead if tightened securely. PVC is mated by the slip joint method which results in smooth joints inside the pipe. It can be purchased from any plumbers supply house and/or most hardware stores and is nominal in price, ranging around 15c a lineal foot. Two or three elbows will be needed in an average job and they cost about 75c each. My job cost ran about $6.00.

A few rules, if followed closely, will result in a good job. Do not bend the pipe more than a few degrees or it will kink. Be sure to clean inside of the pipe after making a cut. Lastly make certain the pipe is fastened securely or it may be pulled apart while in use.

If you can run the piping from the shack wall to the outside entrance point of your antenna system this will be the best type of installation, however I ran mine only far enough to bypass the bad obstruction points and get the cable out in the clear. If you run the entire length you will not need the sheet metal entrance trough such as I used. As you read on you will see the need of this entrance. If you follow my system it is a must as it positively channels the line into the pipe without hanging it up on the mouth of it. I learned this the hard way and had to go back up in the attic again to install the trough. The trough can be made from any scrap sheet metal or a large tin can which is cut open at both ends and flattened out. Shape to suit the individual job.

When the piping is completed there remains one more ticklish job before you are finished, which is running the first line through the pipe. This is the lead line and remains in the pipe system at all times. The best way to introduce this line is with the help of an elec-

trician's snake if it is possible to borrow one. If you can't borrow one then try a very stiff piece of heavy wire. When the snake is run into the shack tie the come-a-long onto it and pull it back out bringing the other line out with it. Now go back to the other end and tie a large knot in the line and again go to the other end and continue to pull the line until the knot appears. You now have twice the amount of line that is needed to make the journey through the pipe. Pull about ten more ft. or so far added precaution and cut the line. You now have a Come-a-Long.

Once the line is fed through the pipe it remains so for all time and at no time should it be pulled through the pipe in either direction beyond the knot which marks the center of the line. To use the line pull it through till you have the knot accessible. Now fasten cable or whatever is to be pulled through to the line by the knot with electrical tape, using plenty to make certain that it is not pulled free of the line while in the pipe. Do not make a bulge in the line nor any projection that may catch in the pipe. Lay your cable neatly in a coil that will pay out freely and then pull the line back through from the other end bringing the cable with it. Remember not to pull the line too far beyond the knot or the other end may be lost in the pipe. Feeding a new line through the pipe is very difficult when there are other lines present. When pulling a cable use a slow steady pull and do not jerk if it seems to hang up. Pulling it back a few ft. will generally free it so that it will pull the rest of the way through.

It is a good idea to put some sort of a stop on each end of the pulling line to prevent its being pulled completely through the pipe. When not in use the line can be coiled up in a neat bundle and tied out of the way. You will come up with ideas of your own which will suit your needs and you will be glad you spent the time and money on it the first time you use it. I have just pulled my fifth cable through without a hitch and the XYL didn't even know I was doing it.

For those of you that do not have a frame house or wall to go down through but must feed through the air space between a block wall and the plaster the alternate for a masonry wall insert will probably be the solution. Everything remains the same except the manner of installing the pipe at the top of the wall. Here you will have to reduce the pipe opening to match the available space where the cable will enter the wall. This can best be done with a home brew metal shield fastened between the pipe and the opening in the wall. Make the portion of the shield which goes into the wall space about 5" wide at the bottom end to allow the cable to spread out a bit as the cables will have to run next to one another as this air space is generally only ¾". As a last resort you could enter the shack through the ceiling plaster but make it neat if you do.

There it is. Never again will I dread putting up a new antenna because I have to pull lines through the attic. . . . K4FQU

Ham Weathervane

W2NSD

Perhaps you've never priced a weathervane. After seeing the first ad by Out-O-Door Products I immediately went to my trusty mail-order catalog and found that the cheapest they had was almost double the $4.75 Out asks (postpaid, by George). Since I frequently find myself bogged down in QSO's just like everyone else I thought that the least I could do while trying to think of something intelligent to comment about was to give an accurate report on the weather, including the wind direction.

Out has quite a weathervane . . . beautifully balanced and extremely sensitive due to a ball bearing movement. It is made out of aluminum so you don't have to climb up and paint the dratted thing every year or so. It is 30" long (much bigger than most weathervanes) so you can see it from the other end of town if you want.

You would do alright with this gadget at $9.95 . . . and at $4.75 you would do well to send immediately before they find out what their product is really worth.

Of RTTY

and the TUZ terminal unit

Frank Van Brunt W3TUZ
1003 No. Belgrade Road
Silver Spring, Md.

This terminal unit is the third type of a series of transistor terminal units that have been built over the past few years. The initial effort was the usual first effort, wherein the design procedure was merely to take the circuit of a vacuum tube terminal unit and replace each circuit by the equivalent transistor circuit—a grand total of seven transistors. It worked after a fashion, but alas, the fashion was not very good. The second generation of the series used only three transistors, did an appreciably better job, and was duplicated by a considerable number of the local gang. These units have been giving good service for the last two years. While the design was simple and the performance was as good as the average ham terminal unit, it was not as good as the best of them. This model, Mark III if you will, is the result of continuing efforts to increase its effectiveness and has performance that is as good as the best and superior to most. In the process transistors have been added and the circuit complexity increased somewhat, however the results have fully justified these changes.

This terminal unit was designed solely for performance—the only limitation that we put on complexity was that it be readily built by the average ham. In terminal units there are three areas in which you can seek better performance—first is in the basic electronics of the unit, limiters, adders, triggers, and selector magnet circuitry; second is the area of filters independent of the electronic circuitry; and third are the retiming and signal processing techniques used in regenerative repeaters. This terminal unit does an excellent job in the first area, while in the second area—filters, it uses good basic design and includes optional plug in facilities for those who want to build and use the better types of modern filters. It incorporates no facilities for retiming, but the design is such that this may easily be incorporated later if it is desired. At this stage in the game regenerative repeaters are relatively rare in ham TU's but there is no reason that it could not be added later on, for a transistor unit should not be too difficult to build.

When we finished the prototype, we took it over to the shack of W3PYW to compare it with the multitube, relay rack mounted monster which has earned him first place in a number of RTTY sweepstakes contests. We set up two terminal units, two printers, and connected the resulting maze to a common receiver. Then off we went, searching for lousy signals so we could compare performance. The lousy signals were relatively easy to find! The result was a draw—there was substantially equal performance by both units, but the size differential was rather horrendous to contemplate. The total power consumption of the

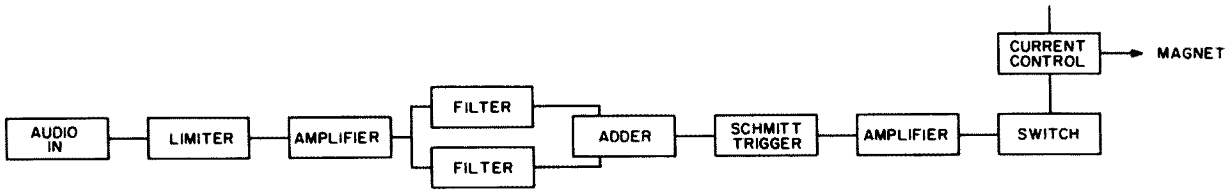
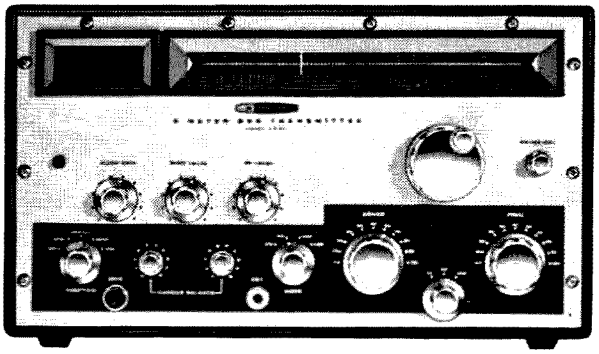
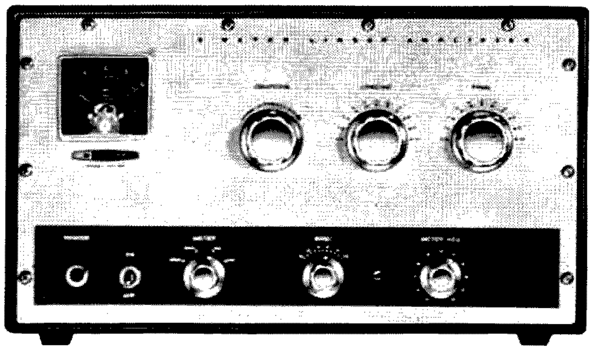


FIGURE 1
BLOCK DIAGRAM

the most SSB on SIX comes from HEATHHKIT!





HX-30 6-METER SSB TRANSMITTER

Most of the SSB signals on 6 meters today emanate from Heathkit HX-30's because of the extra value, quality, and features this fine transmitter offers. The versatile HX-30 provides three types of transmission, SSB (upper/lower sideband), AM & CW. Its stable VFO with special anti-backlash helical gear drive assures velvet-smooth tuning and a phasing type SSB generator plus heterodyne circuitry permits operation as clean as any low band unit. An audio filter limits band-pass for improved sideband suppression...gives your signal extra "punch" and readability under adverse conditions. Other features include grid-block keying with key click filter, two crystal positions for net or MARS operation, push-to-talk circuitry and built-in VOX with anti-trip circuitry. Delivers 10 watts P.E.P. RF output to antenna. Covers 50-54 mc in four 1 mc segments. Order your HX-30 now and save with Heathkit!

Kit HX-30...46 lbs....no money dn., $18 mo. **$189.95**

HA-20 6-METER LINEAR AMPLIFIER

A perfect style and performance mate for the Heathkit HX-30 SSB Transmitter! The HA-20 Linear Amplifier provides the extra power you need for reliable communications during band openings. Efficient design requires just 2.5 to 10 watts P.E.P. driving power for a full 70-watts P.E.P. output to the antenna. Its tuned-grid input permits a variety of drive power levels and the tuned, link-coupled output easily matches any 50 to 75 ohm coaxial transmission line. Complete RF shielding minimizes TV interference and adds high circuit stability for consistently fine performance. The push-pull 6146 final amplifiers are neutralized for maximum stability and fan forced-air cooled for long tube life. Panel metering of final grid current, plate current, and relative power output is also featured. Order these two fine rigs now or add the linear at any time for extra power on six!

Kit HA-20...38 lbs....no money dn., $10 mo. **$99.95**

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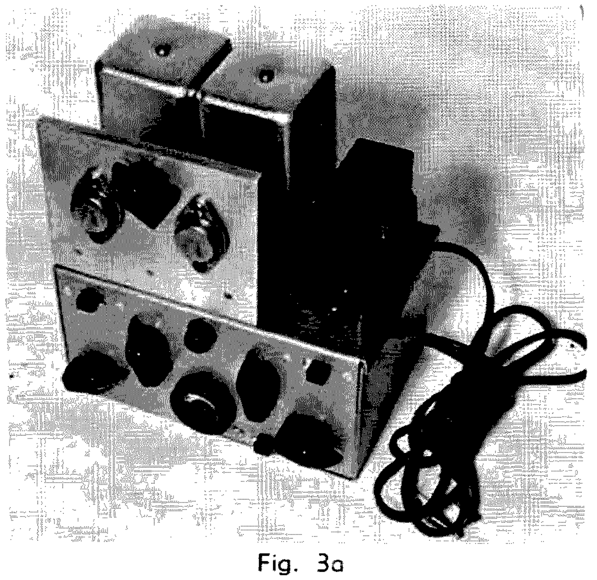


Fig. 3a

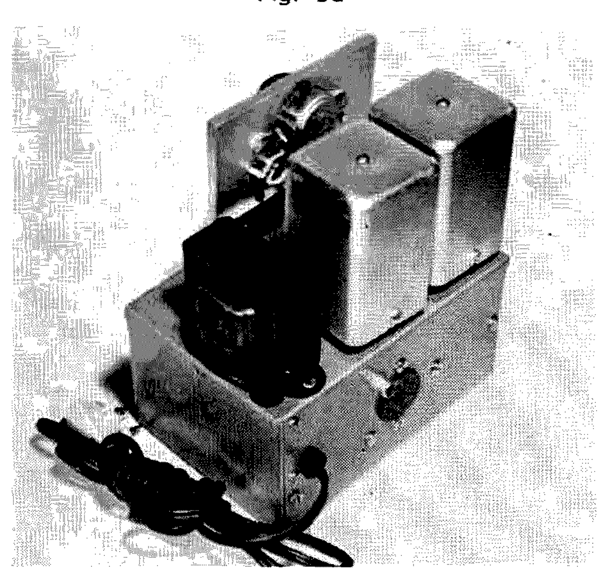


Fig. 3b

entire transistor unit was less than that of the final tube of the vacuum tube unit. A second test was made when I visited a friend who had a printer but no terminal unit. Aside from his disappointment at not being able to use his polar relay or the cubic foot of boat anchor he had for the local loop supply, all went well. We even called in on a local ARMS RTTY net for an hour drill period. By the end of the drill period it was quite evident that we were copying as much as the NCS—and as my friend remarked, he was using aa seven-foot relay rack full of equipment!

As for the specifics, it is basically a transistor terminal unit, completely electronic and self contained: no relays, polar or otherwise, are used to cause hash and get out of adjustment, and no separate power supplies are needed. You feed the audio tones from the receiver, plug in the selector magnet of the printer, and you are in business. It also provides local copy and concurrently an adjustable FSK bias voltage for use when transmitting. The only external circuitry necessary is the conventional transistor or diode frequency shifting network on your oscillator.

The design of the unit is straight forward. The basic functions are given in the block diagram in Fig. 1. The audio input from the receiver is first fed through a simple yet effective limiter consisting of two silicon junction diodes, D1 and D2. Since the peak voltage across either diode is limited by the forward conduction voltage of the other diode, the PIV requirements are negligible and practically any silicon junction diode is usable. The output of the limiter is then amplified by transistor Q1 and the output is fed to the two filters. The output transformer T1 is an ordinary tube type, 2000 ohms to voice coil. Special transistor transformers are available, but they are usually more expensive and often less efficient, while the saving in space is not too significant.

The low impedance output of the transformer is ideal for coupling to the usual toroids used in the filters, since relatively few turns are needed and the number can be easily adjusted to equalize the outputs of the two channels. The dpdt switch following the filters provides for mark-space reversal. This is necessary in cases where the transmitting station has the mark and space frequencies reversed, and is quite handy when you have your bfo on the wrong side of the signal since it is far easier to throw the switch than to retune the receiver. The outputs of the two filters are then rectified by diodes D3 and D4. These are placed so that you have opposite polarity and the outputs are filtered and summed in RC networks. If you have equal signals in both channels and equal outputs, the summed voltage will be zero—thus you have the usual cancellation characteristics of an FM discriminator. Capacitor C7 and switch SW2 are provided so that you may choose either ac or dc coupling. Briefly stated, in the ac position (SW2 open) the magnet current will be switched on a change in the level of voltage from the discriminator but the resting position may be adjusted so that the machine does not run open when no mark tone is being received. This is quite convenient in eliminating the various misprints one gets when the mark tone is tem-

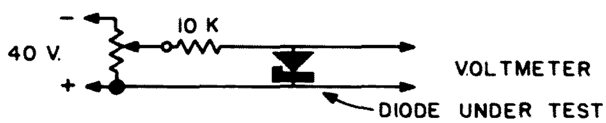


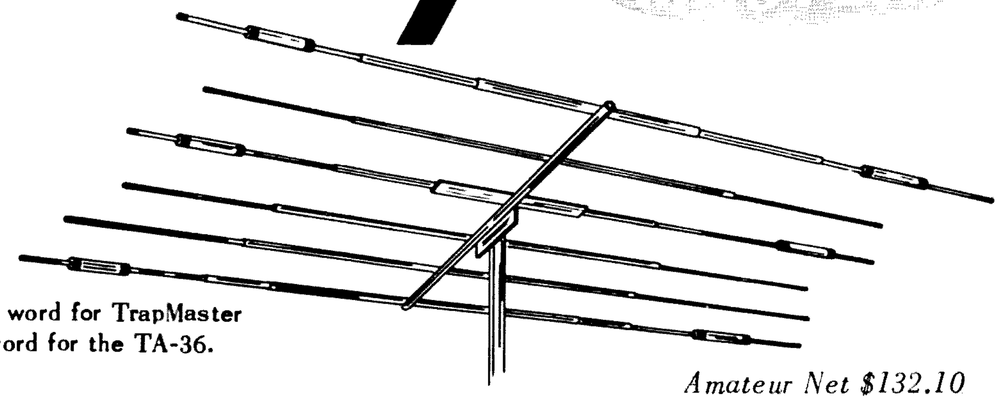
FIGURE 2

Mosley

TRAP MASTER

MODEL TA-36

for 10-15-20 meters



Incomparable is the word for TrapMaster and terrific is the word for the TA-36.

Amateur Net $132.10

The new clean-line TA-36 . . . the three band beam that will give your signal that DX punch!

This wide spaced, six element configuration employs 4 operating elements on 10 meters, 3 operating elements on 15 meters and 3 operating elements on 20 meters.

Automatic bandswitching is accomplished by means of exclusive design high impedance, parallel resonant "Trap Circuits". Built for operation at maximum legal amateur power.

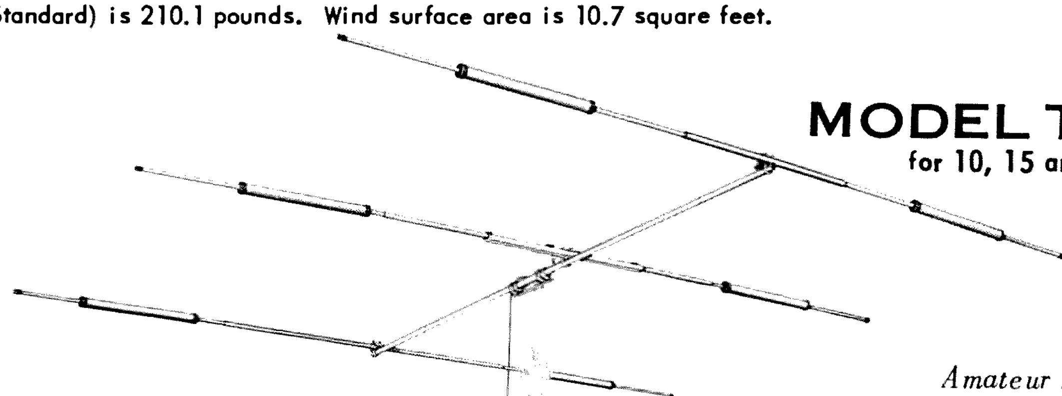
Traps are weather and dirt proof offering frequency stability under all weather conditions. Just one coaxial feed line is needed. 52 ohm, RG-8/U is recommended.

Antenna comes complete with illustrated instruction booklet and color coded elements for ease of assembly.

SPECIFICATIONS and **PERFORMANCE DATA:** Forward gain on 10 meters is 9 db., on 15 meters is 8.5 db. and on 20 meters is 8 db. Front-to-back is 20 db. or better on all three bands. SWR is 1.5/1 or better at resonance. Transmission line - 52 ohm coaxial. Maximum element length is 29 feet. Boom length is 24 feet. Turning radius is 19' 3". Assembled weight is 69 pounds. Wind load (EIA Standard) is 210.1 pounds. Wind surface area is 10.7 square feet.

MODEL TA-33

for 10, 15 and 20 meters.



Amateur Net $104.75

Three element beam provides outstanding performance on 10, 15 and 20 meters. Exceptionally broadband for excellent results over full Ham bandwidth. Exclusive MOSLEY trap design provides resonant frequency stability under all weather conditions. Easily handles full KW, amplitude modulated. Traps enclosed in aluminum are weather and dirt proof. Element center sections of double thickness 6061-T6 aluminum to reduce sag. Boom requires no bracing. Heavy duty universal mounting plate fits masts up to 1½" OD. Feed with one coax line. RG-8/U is recommended.

SPECIFICATIONS and **DATA:** Fwd. gain up to 8 db. Front-to-back is 25 db. SWR is 1.1/1 or less, at resonant frequencies. Maximum element length is 28 feet. Boom length is 14 feet. Turning radius is 15.5 feet. Assembled weight is 40 pounds. Wind surface area is 5.7 square feet. Wind load is 114 pounds. Shipping weight is 53 pounds.

MOSLEY Electronics Inc., 4610 N. Lindbergh Blvd., Bridgeton, Mo., 63044.

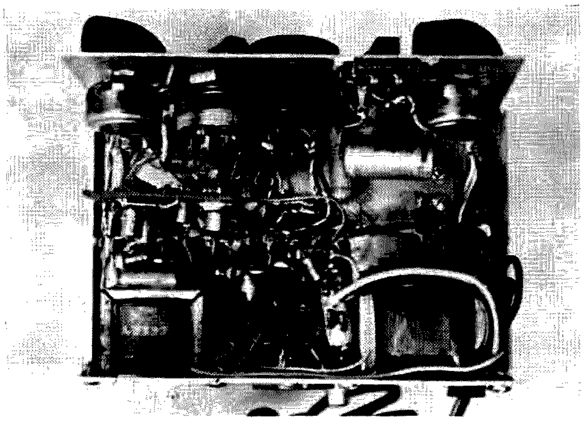


Fig. 4

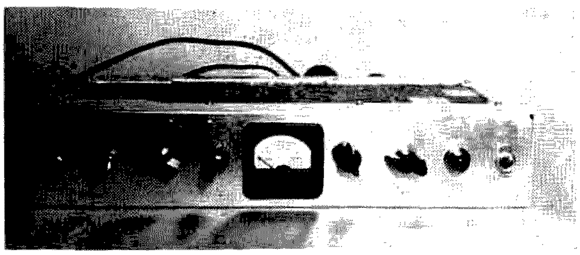


Fig. 5c

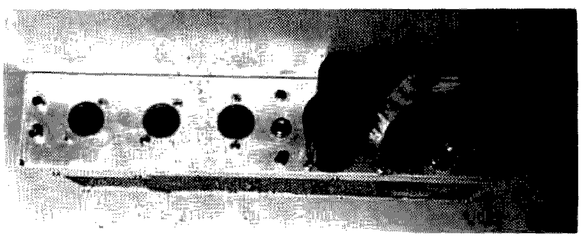


Fig. 5b

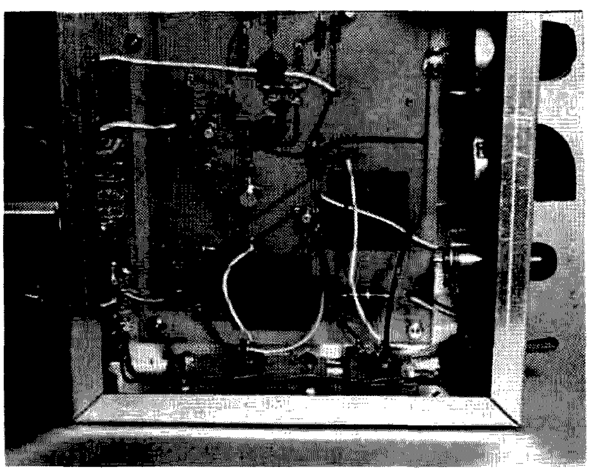


Fig. 5a

porarily lost, and also provides protection against the effects of a continuous unwanted signal in either of the two channels. In the dc position (SW2 closed) you have a greater range of adjustment for various types of distortion, although there is still a considerable range of adjustment available with ac coupling. Potentiometer R8 is a sensitivity level control and furnishes protection on occasion against misprints caused by relatively weak unwanted signals. It should be adjusted for optimum copy. When interference is not a problem it should normally be set so that the typical voltage swing at its output is equal to the range of voltage adjustment obtainable from R14. This permits the widest range of adjustments for distorted signals with maximum sensitivity.

Switch SW3 has three positions: local, receive, and transmit. The local and the transmit positions are the same except for the extra set of contacts which are used for station control on transmit. With RTTY your hands have more than enough to do—one switch is plenty! The resistor network R9 and R11 and zener diode D5 give a variable output voltage for controlling the frequency shift of the oscillator of the transmitter and at the same time provide a voltage to the subsequent stages (via resistors R10 and R13) which furnishes local copy. The FSK voltage can also be used for keying an AFSK oscillator if you want to join the 2 meter RTTY gang.

Transistors Q2 and Q3 form a complementary emitter follower, providing both isolation and impedance transformation, the circuit being analogous to the conventional vacuum tube cathode follower. The complementary circuitry provides for equally effective operation on both rising and falling waveforms. Transistors Q4 and Q5 form a Schmitt trigger and the output from the collector of Q5 is a square wave—regardless of the shape of the input signal. Potentiometer R14 provides an adjustable trigger level for this circuit and permits a wide range of adjustment for distortion of the incoming signal. Transistor Q6 performs three functions: it serves as a buffer-amplifier (mostly buffer) between the Schmitt trigger and the switching transistor (Q7), it provides the phase reversal which is necessary for using the FSK voltage for local copy, and it permits the application of a positive bias to the switching transistor to assure effective cut-off of the transistor.

Transistor Q7 is simply a switch to turn the selector magnet current off and on. Since the input is a square wave (i.e. either off or on) the actual power dissipation is very low. The steady state dissipation is 100 milliwatts or less in either the off or on state, and during switching it reaches an instantaneous peak value of about 1 watt. The average power dissipation on continuous reversals (RYRYRYRYRY . . . . .) should not exceed 150 milliwatts.

Actual transistors tested have ranged from 300 mw units up to the largest of power transistors —in practice we would suggest medium power units merely because of the added safety factor. The current regulator transistor Q8 and the associated circuitry provide a very low resistance path when the magnet current is less than the required value—when the current reaches the required value, the voltage drop across the transistor increases until it is sufficiently large to assure this desired current. This transistor has to dissipate about 4 watts with current on, thus it must be a medium power transistor with a moderate heat sink. The zener diode D10 provides the reference voltage for this current regulator circuit and a 3 or 4 volt unit is recommended—theoretically the lower the voltage the better, but the actual value is not critical. Higher voltage units may be used with a very slight decrease in performance, but if they are, the value of R28 should then be increased somewhat to protect against excessive current.

The power supplies are conventional in every

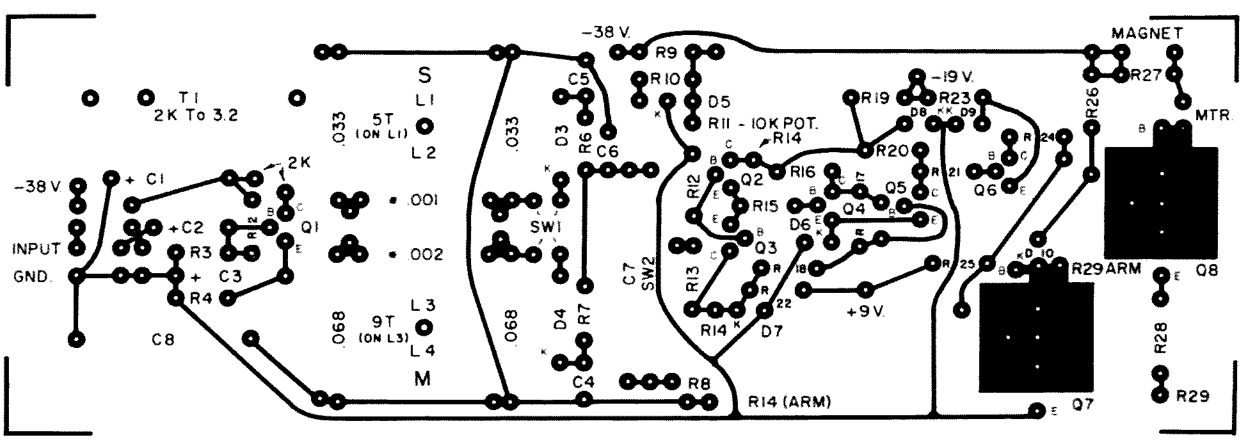


FIGURE 5d

respect. The diodes used in the high voltage supply are 100 volt PIV units with a current rating of .25 a or more. The bias supply used surplus 1N482 diodes which were available from the junk box, but any diodes rated for 15 v PIV, 10 ma or better can be used—and those are very easy specs to meet or beat. You could probably save some space, components, and initial expense by using a standard 9 volt transistor battery and eliminating the bias supply and zener diode D7. Another possibility which might be tried is to use a simple half wave rectifier in the bias power supply. Actually our supply of the aforementioned 1N482 diodes was such that we just went ahead with the bridge rectifier since its output does not need as much filtering as the half wave type. The current drain here is very low and the filter used should be ample.

Fig. 6a

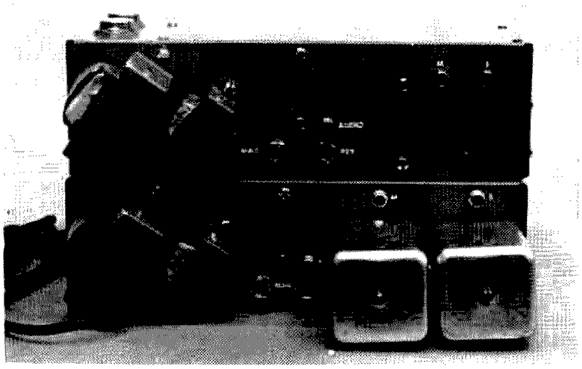


Fig. 6b

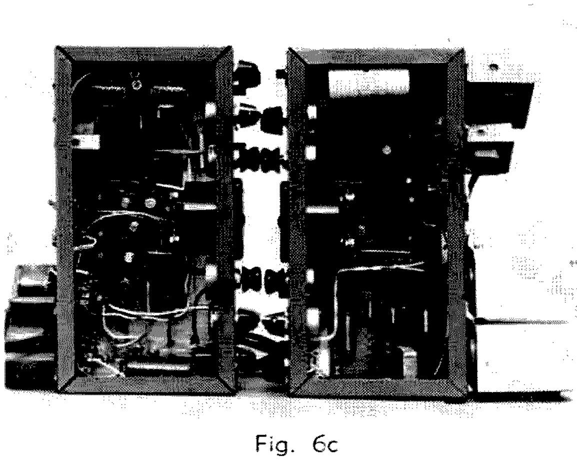


Fig. 6c

With the exception of the diode D10 in the current regulator circuit, all the zener diodes specified are Hoffman HB-1. These are listed in their catalog as general purpose diodes guaranteed to have a PIV greater than 7.5 volts. We have bought and used these over a period of years and have checked hundreds of them. They practically all have zener points within the range from 7.8 to 15 volts with the vast majority falling within the 8 to 12 volt range. These are undoubtedly fallout from their regular zener diode production which do not meet their commercial standards—but they are quite adequate for a variety of amateur applications. At 44¢ they are a real bargain and we've used them in a large number of things we've built. They are more effective than electrolytic capacitors, since their impedance is not frequency dependent, and in a terminal unit we are dealing with some very low frequencies. In addition they take up a lot less space than electrolytics and as long as you stick to the HB-1 variety they're cheaper. Checking them is a simple matter, just use the test lash up given in Fig. 2. The power supply can be that of the unit. The value of the potentiometer is not critical but the fixed resistor in series with the diode should be sufficiently large to limit the current to less than 10 ma. Just connect the diode and run the potentiometer slowly up. The voltage should rise smoothly until the zener voltage is reached. Increasing the pot further should not cause any significant increase in voltage. If you have less than a volt or so across the diode, you have the polarity of the diode reversed; just turn it around and try again! If you get a continuously increasing voltage with no zener point, either it has no zener point or it is above the voltage range you have tested it for, but in either case don't despair, the diode will be quite satisfactory for either D1, D2, or D6. Test them all at the same time and mark the zener voltage on each. Select one of the higher voltage units, on the order of 10 or 12 volts for D5. Use the lowest voltage unit, preferably between 8 and 9 volts for D7. If you are unable to find one this low, D7 may be replaced by a 100 mfd 12 v electrolytic capacitor. As for D8 and D9, the actual voltage is not critical and can be anywhere in the 8 to 12 volt region—however D8 should have a higher zener voltage than D9; a half volt differential is quite adequate. This differential

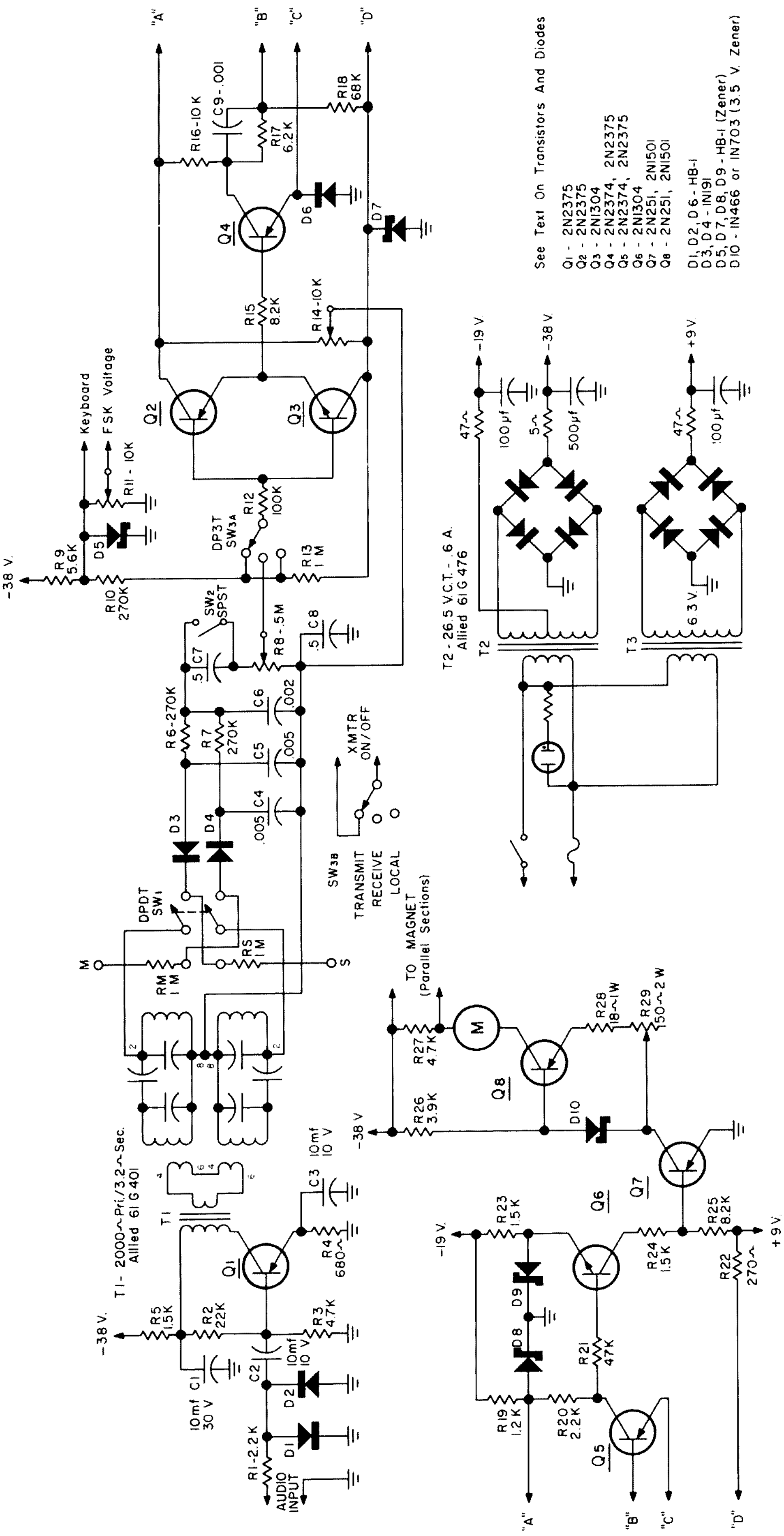

See Text On Transistors And Diodes
Q1 - 2N2375
Q2 - 2N2375
Q3 - 2N1304
Q4 - 2N2374, 2N2375
Q5 - 2N2374, 2N2375
Q6 - 2N1304
Q7 - 2N251, 2N1501
Q8 - 2N251, 2N1501
D1, D2, D6 - HB-1
D3, D4 - 1N191
D5, D7, D8, D9 - HB-1 (Zener)
D10 - 1N466 or 1N703 (3.5 V. Zener)
T1 - 2000~Pri./3.2~Sec. Allied 61 G 401
T2 - 26.5 V.C.T. - .6 A. Allied 61 G 476
Keyboard
FSK Voltage
XMTR ON/OFF
SW3B
TRANSMIT
RECEIVE
LOCAL
TO MAGNET (Parallel Sections)
AUDIO INPUT

FIGURE 7

assures that transistor Q6 cuts off.

The transistor type specified are modern units that you can buy at reasonable prices, plug in, and be assured of satisfactory performance. There are cheaper (but very little cheaper) transistors which can be used if you are willing and able to go through a selection procedure to find the satisfactory units. The 2N2374 and 2N2375 units are low cost modern PNP units with relatively high voltage capability (—35v). They also have high beta without having the exceptionally wide beta spread of some of the less expensive units. They aren't shown in the photos since they came on the market after the photos were taken, but they have been tested and used in a number of units and gave good performance without selection. If you have some means of checking beta, use the highest beta transistor for Q4 and the next highest beta unit for Q5. The 2N1304 are moderately priced NPN transistors and perform very nicely in the circuit. The output transistors used in the various units have been of a wide variety of types, in general the 2N251 or any TO-3 (diamond base) transistor with a 50 volt rating and reasonable beta will be easy to mount and should do an acceptable job. For those who prefer the stud mount, the 2N1501 has done a fine job in a number of these units.

Probably the best way to indicate some of the many ways in which the terminal unit can be packaged is to take you along the path I travelled. This runs from the first complete unit, which resulted from successive modifications of an earlier transistor terminal unit, on through to the latest printed circuit version with relatively compact packaging. It is now in what I consider to be relatively finished form—around my shack these things are only relative, my favorite activity being design and construction with the actual operation normally playing a secondary role. The other reason for the qualification is that I have since built up an AFSK tone generator for the unit and it is presently being tested both at the home station and by a number of the local gang. It's not yet in printed circuit form, so that's another story for another day.

The first unit was built on a 3x4x6 inch box cabinet which started out as a three transistor TU about two years ago. To this I added the transistor current regulator circuit and mounted the extra transistor and the switching transistor on a piece of aluminum which was bolted to the top of the chassis (Fig. 3). The piece is far more substantial than is actually required, but it had the merit of being readily available! Potentiometer R29 was placed on the same heat sink later when I found I needed room for an extra control on the unit. While this version gave improved performance, I felt the need for a trigger circuit to improve performance and ensure that the unit did not sit in a half on—half off state. The design work on the trigger circuit was done on a separate board and started out as a most impressive array of transistors, and underwent a long series of revisions, refinements, and simplification until I was satisfied that I had reached the point where any further simplifications would degrade performance. The final form was then built up on a small piece of perforated board which was mounted by means of the wire leads to the terminal strip beneath the chassis (Fig. 4). This is not the best of construction techniques, but things were getting rather crowded and this did a good

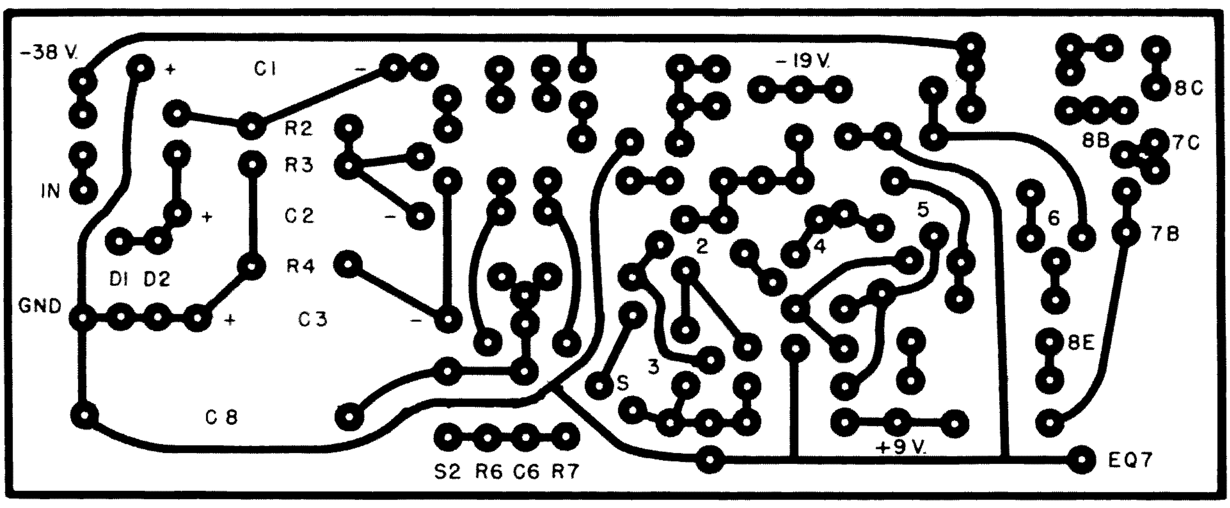


FIGURE 9

job of using what little space was available. The power supply for the 9 volts of bias was also crowded in beneath the chassis. The unit contained a fixed resistor rather than a potentiometer for R8, but is otherwise identical electrically to the circuit diagram and the other units. The performance of the unit was excellent—but the possibilities for mass duplication were small indeed!

The next step was a lengthy conference with W3ITO, who during the normal daylight hours spends his time packaging electronic equipment for some rather fancy end uses—and in considerably smaller packages. After some discussion we settled on some general ground rules for the subsequent units: first they should be relatively easy to duplicate, second they should all be designed for standard parts and components, and last but not least they should be relatively flexible, permitting the board to be used in a number of different mounting configurations. The next work was Fred's, and about a week later (let's be honest—it was more than a week) he reappeared with some beautiful printed circuit boards, made of epiglass, neatly eyeletted and everything. The resulting unit is shown in Fig. 5. These have plenty of room not only for the circuitry, but even have provisions for mounting the toroid filters and transformer T1 directly on the printed circuit board. They also provide space for mounting 2N173 type transistors (guess which transistors Fred had in his junk box?), which are considerably larger than necessary, but which provide good performance without requiring a heat sink. My first reaction was that the boards were huge indeed—but in retrospect, after building some of the smaller units I must confess I am far more pleasantly disposed toward this version. It is relatively large but it is a real pleasure to work on a unit of reasonable size and not have to contend with small clearances and tight quarters. You will note that in this unit we cut a section out of the top of the 7x15x3 chassis that we mounted the unit in, so as to provide access to the bottom of the printed circuit board. It's lucky we did—one of the transistors worked fine for ten seconds and then slowly died! In later units we have been brave (and I suspect foolhardy) and we would recommend this technique for those of you who would prefer a 1 minute task to a 2 hour task in case things do not go perfectly the first time around. If you are brave you can do the job carefully and then mount the circuit board on stand offs on the bottom of the chassis; we also put a thin sheet of mylar between the board and the chassis just in case. The large chassis size provides plenty of room on the front for mounting the controls, and as one of the gang remarked the unit is made to order for those who like to have knobs to play with. We also mounted two extra octal sockets on the rear of the chassis so that if we ever want to convert from the fixed filters to plug in filters, the conversion will be a relatively simple matter. The third octal socket, which is in the center of the chassis in the rear provides for *all* the inputs and outputs of the unit. Thus when changing from one TU to another we have only one octal plug to transfer rather than the usual morass of wires (magnet, keyboard, audio input, FSK voltage, etc.) that one is normally

faced with. It makes life considerably easier, and for added convenience in testing units or operating away from home we have provided redundant jacks for the magnet, keyboard, and audio input.

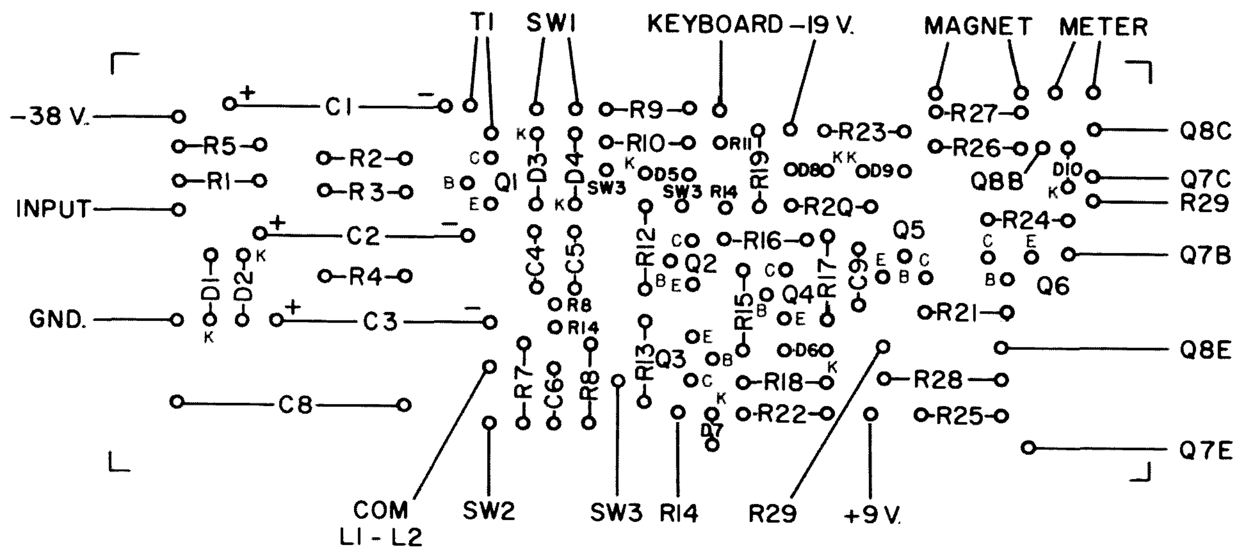
In the version shown in the photograph we did not mount transistors Q7 and Q8 on the printed circuit board, but used 2N1501 transistors which we had on hand and mounted these on small aluminum heat sinks on the side of the chassis (See Fig. 5c). The leads were then wired to the appropriate points on the printed circuit board.

The final version, which is the neatest looking of the units is shown in Fig. 6. The circuit diagram is given in Fig. 7 and the parts list in Fig. 8. The photographer was economizing, so we have two units which are quite similar shown—there are differences which illustrate some of the options open to the builder. These units use a much smaller printed circuit board—roughly 3 inches by 8 inches in size. The layout of the board is shown in Fig. 9 and the parts layout on the top of the board is shown in Fig. 10. This board provides a large percentage of the circuitry of the unit, but since it provides for separate filters, controls, output transistors and power supply, it does provide a considerable degree of flexibility in packaging. It can, of course, be readily adapted to relay rack mounting by the use of a standard 3½ inch relay rack panel. One of the units pictured uses 2N251 transistors and has the toroid filters mounted integrally in the unit. The other unit shown uses plug-in filters and has 2N1501 transistors mounted internally. This actually has an extra transistor mounted internally to be used as an additional output for a reperforator. This permits a reperf to be used along with the page printer and gives separate control of magnet current. The circuitry for this modification is shown in Fig. 11. The jack which is paralleled with the magnet output of the octal plug on the other unit is here wired up to handle the extra output. The plug-in filters may be mounted in the Vector C-12 cans shown in the photo, or may be more complex units mounted in a 3x5x10 chassis—which is the chassis size used for these two units.

With this size circuit board you can choose your own size cabinet and your own panel layout—the space occupied by the board is small indeed. Please don't get the idea that this represents the ultimate in packaging techniques and shrinkage. Had we not adhered to the original requirements of ease of construction and standard parts, it could have been made considerably smaller. If you want to try, just use smaller size potentiometers, wind a single transformer for the two voltages required, use a miniature meter and miniature electrolytics and you can end up with a considerably smaller unit.

The filters used in the terminal unit are bandpass units of the conventional type.* The

* For more complete discussion see article in Nov 62 issue.



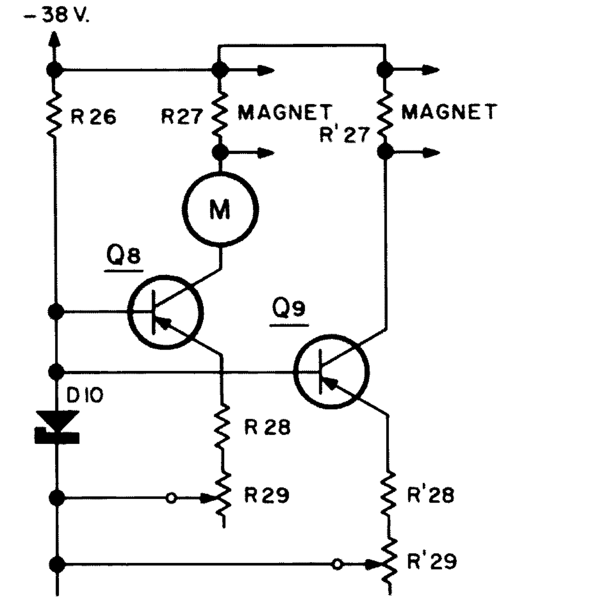
NOTE: C7 Is Mounted On Switch SW2 On Front Control Panel.
K Is Marked For Cathodes Of All Diodes.

FIGURE 10

PARTS LAYOUT - COMPONENT SIDE OF PRINTED CIRCUIT BOARD

circuits and the component values are given in Fig. 12. There is also an illustration of the set up for tuning the filters. Tuning is simple using the test set up. Connect it to the LC pair to be tuned, short out the other LC pair of the filter you are tuning, and either by trying different capacitors, or by adding or subtracting turns from the toroid, bring that section to resonance on the desired frequency (either 2125 or 2975 cycles). Then switch the short to the section you have tuned up and proceed to une the other section. Note that this procedure effectively adds the coupling capacitor to each LC pair. The coupling capacitor is chosen from normal 10% capacitors, which should be close enough for proper performance. You should preferrably tune the output section with the load connected so that tuning does not shift after the unit is wired up. The values given are for a bandpass of about 200 cycles, which is our recommendation for general use. If toroids or space are problems, you may prefer to use only one toroid in each section; this will not give quite as good performance as the bandpass unit with two toroids per section, but the performance will still be considerably better than the average terminal unit. Just omit the coupling capacitor and the second LC pair.

When building the unit you can either mount the filters on a terminal board and put it inside the unit, or you can make each of the filters a plug-in unit. The numbers at the terminals are the base connections for the octal sockets used with the plug-in units. We found it handy to have these standardized, thus we could check out terminal units before the filters had been finished. The plug-in units also permit you to have other filters with narrower bandpass or special filters for short shift. By making up just one filter for 2550 cycles, you are equipped for copying the commercials using 425 cycle shift. The dual plug-in units are each mounted in a Vector C-12 can which is 2x2x3 in size. The Millen 74400 can has also been used, but things are a little more cramped inside. When the units are finished and connected in the circuit, check to see that the bandpass is smooth across the top and not double humped. If you do have a double hump with the units operating with the normal load, add a resistance across the output toroid of each filter. By careful selection of the resistor you should have no difficulty in smoothing the response. Without a load you will surely have a double humped curve, and the value of resistance needed will depend to some extent on the betas of transistors Q2 and Q3. You may not need any—if not, fine.



Values Are Identical To Those Of Normal Circuit.

FIGURE 11
CIRCUIT FOR OPERATING TWO PRINTERS

Checking out the unit is a relatively simple procedure. For the initial check, disconnect the lead supplying voltage to Q_7 and Q_8. Plug in the unit, apply power, and check the power supply voltages. First check the voltage at the collector of transistor Q_5. By varying the setting of R14, the voltage should at some point shift from a little less than one volt to approximately the zener voltage of D_8. You should *not*, repeat *not*, be able to obtain an intermediate voltage reading regardless of the setsing of R14. If you can, the transistors you are using for Q_4 and Q_5 probably have too low a beta. The switching should occur when R14 is set approximately to center scale, i.e. when the voltage on the center arm of the pot is about −1 volt. One unit on which detailed voltage measurements were made switched on a .03 volt change on the bases of Q_2 and Q_3. The next step is to check Q_6. The collector voltage should switch from about the zener voltage of D_9 to about zero volts. A further check should be made on the voltage from the collector to the emitter of Q_6. When this transistor is conducting, the voltage drop should be less than one volt. If it is higher than this, either use a higher beta transistor for Q_6 or decrease the resistance of R21.

Next check the mounting of transistors Q_7 and Q_8 to see that you have not grounded the collectors in the process of mounting and heat sinking them. (This bit of advice is the result of some experience!) After reassuring yourself on this point, connect the power to the units, plug in the selector magnet, and turn on the unit. By now varying the setting of R14 you should be able to switch the magnet current off and on. Then with the current on adjust R29 for the proper magnet current. For Model 14 or Model 15 machines with pulling magnets, be sure the two sections of the magnets are in parallel and run 120 ma to the paralleled magnet sections. With holding type magnets, less current should be satisfactory. If you are unable to draw the full 120 ma with R29 set at minimum resistance, you probably have a very low zener voltage diode for D_{10} and the cure is simple—merely decrease the resistance of R28. Normally you set R29 and leave it alone, so if space is a problem you can locate this pot at any position on the chassis you have the room for it. Alternatively, you could merely select R28 for the proper current and delete R29 completely. Check the voltage from the collector of Q_7 to ground. When the magnet current is on this voltage should be less than one volt. Readings of .1 volt to .4 volt are typical. If it is more than a volt, the beta of the transistor is probably low—but with identical transistors being used you can easily switch transistors and see if this improves the situation. Actually when you use power transistors here you are normally well off since the betas are usually considerably higher at the 120 ma operating point than they are at the full rated current the devices are designed for. You can compensate for an extremely low beta unit by decreasing the resistance of R24 from 1500 to 1200 or even 1000 ohms. A number of the units built have used 2200 and 2700 ohms for this resistor, but the 1500 has been specified to provide latitude for the lower beta transistors.

Assuming all works well now, the only remaining step is to feed audio tones into the unit and see if it plays. The audio tone is limited by D_1 and D_2 (an oscilloscope will demonstrate this visually), it is then amplified by Q_1, and the two filter sections separate the tones. With a mark tone input you should get a positive output at the junction of R6 and R7, while for a space tone you should have a

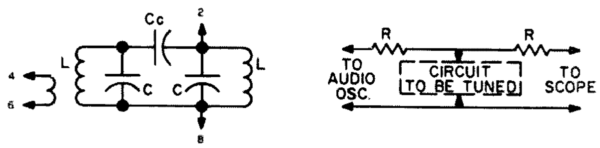


FIGURE 12

L all 88 mhy.		R = 1 meg. or larger
	2125 cycles	2975 cycles
C	.06 mfd.	.03 mfd.
C_C	.0059 mfd.	.0022 mfd.
Link	9 turns	5 turns

negative output. If they are reversed, just throw SW1 and the situation should be as specified. With SW3 in the receive position (center) these tones should switch the magnet current on and off.

Last, but certainly not least, I want to thank the gang who helped me in the process of getting these beasts into their final form, especially Fred, W3ITO who is responsible for the printed circuit board work and who has built, checked out, and struggled with modifications on a number of these units. He's also been willing to test a number of my brainstorms—both good and bad! To Frank W3PYW who has been of great help in discussing RTTY and related problems in general and checking out a numbers of units in particular. To Bob, W3OII for the very fine photos and continuing encouragement in my efforts to get this thing down on paper. He must indeed be persuasive, for these last paragraphs are being written in Paris—and I can assure you there are better things to do in Paris than to write articles on terminal units! And last to the many locals who built them and criticized them.

As for making printed circuit boards, I have no sage words of advice to impart. Just get hold of one of the numerous articles that have been published in the past and get to work, they're *not* difficult. If you're lazy, you might check to see if any of the guys who make printed circuit boards for hams would be willing to make one up for you. But don't write me or any of the hams mentioned above. About three dozen of them have been turned out for the local gang and none of us have any desire to go into the printed circuit business. We've retired. However, if printed circuit boards are new to you I suggest you use a small iron and much caution. The transistors may be soldered directly onto the printed circuit board or you may prefer to use sockets. (ELCO 3304 sockets work nicely.) One of the last two units pictured uses sockets while the other has the transistors soldered directly to the board. If you use the direct approach, get some surgical forceps, they make fine heat sinks while soldering.

Good luck. . . . W3TUZ

Fig. 8. Component Values

Transistors:

Q-1	2N2375
Q-2	2N2375
Q-3	2N1304
Q-4	2N2374 or 2N2375
Q-5	2N2374 or 2N2375
Q-6	2N1304
Q-7	2N251, 2N1501
Q-8	2N251, 2N1501

D-1, D-2, D-6 HB-1 (see text)
D-3, D-4 1N191
D-5, D-7, D-8, D-9 HB-1 zener (see text)
D-10 1N466 or 1N703

Resistors:

R-1	2.2 k	R-11	10 k	R-21	47 k
R-2	22 k	R-12	100 k	R-22	270
R-3	4.7 k	R-13	1 meg.	R-23	1.5 k
R-4	680	R-14	10 k	R-24	1.5 k
R-5	1.5 k	R-15	8.2 k	R-25	8.2 k
R-6	270 k	R-16	10 k	R-26	3.9 k
R-7	270 k	R-17	6.2 k	R-27	4.7 k
R-8	.5 meg.	R-18	68 k	R-28	18—1 w.
R-9	5.6 k	R-19	1.2 k	R-29	50—2 w.
R-10	270 k	R-20	2.2 k	R_M,R_S	1 meg.

Capacitors:

C-1	10 mfd. 30 v.	C-6	.002 mfd.
C-2	10 mfd. 10 v.	C-7	mfd. .5 mfd.
C-3	10 mfd. 10 v.	C-8	mfd. .5 mfd.
C-4	.005 mfd.	C-9	.001 mfd.
C-5	.005 mfd.		

Switches:

SW- DPDT SW-2 SPST SW-3 DP3T
61G401, Stancor A3332

Transformers:

T-1 2000 ohm voice coil Allied Radio 61G401, Stancor A3332
T-2 115 v./26 v.c.t. Allied Radio 61G476, Triad F-40 X
T-3 115 v./6.3 v.

73 Test

Donald A. Smith W3UZN
Associate Editor
Kent A. Mitchell W3WTO

The Hallicrafters SX-140K

Are you in the market for a receiver in the $100 to $125 price range, but undecided whether to purchase a commercially built set or one in kit form? Why not combine the advantages of both and consider the Hallicrafters SX-140K? This is the companion receiver for the HT-40K transmitter kit as described in the May 1962 issue of 73 Magazine.

A ham band only receiver, the SX-140K covers 80 through 6 meters. Priced at $104.95 in kit form (also available factory wired and tested for $124.95), this receiver offers many features not usually found within this price range.

Lest you have misgivings concerning constructing a receiver because of the usual associated task of rf and oscillator stage alignments, let us hasten to mention that the SX-140K receiver kit is supplied with a completely aligned and prewired bandswitch assembly.

The receiver incorporates a pentode rf amplifier, one half of a 6AZ8, with a manual rf gain control in series with its cathode. A 6U8A is used as the local oscillator-mixer stage, its output fed to a 6BA6 *if* amplifier. The oscillator frequency is varied by a main tuning capacitor. No fine tuning control is necessary due to the 25-to-1 tuning ratio of the main tuning, which is very adequate for the 6 inch per band of slide-rule dial provided. The selectively-bfo control in the suppressor grid of the *if* stage is actually a regeneration control and effectively varies the selectivity of the stage from approximately 8 kc to approximately 2 kc. Ad-

vancing the control until the stage breaks into oscillation provides a beat note for CW and SSB reception. Operation and adjustment of this control is both simple and effective.

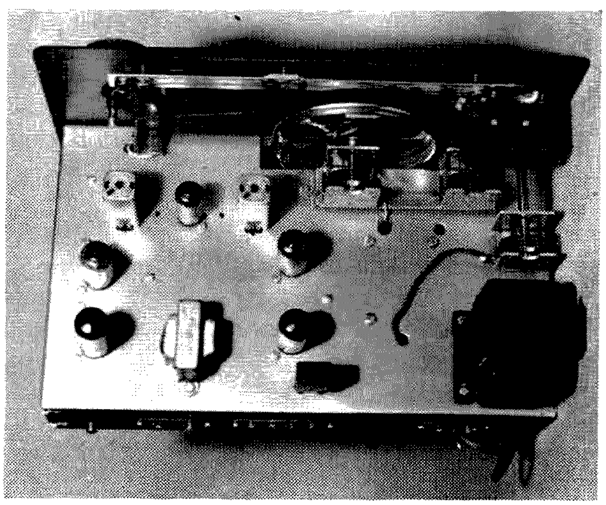
The *if* output signal is coupled to a 6T8A, which not only functions as the detector and first audio amplification stages, but performs as noise limiter and avc control stages as well. Noise limiting is by diode action and avc by the conventional feedback method.

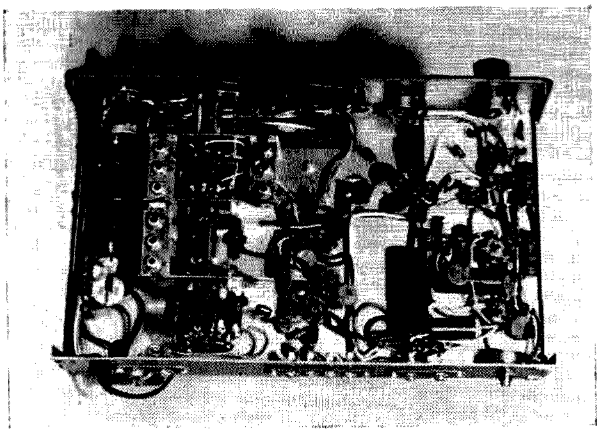
The tetrode section of a 6AW8A is the audio output stage and is connected through an output transformer to a pair of terminals on the rear chassis apron and to a headphone jack on the front panel. Though there is no built-in speaker, there is enough cabinet space for a 3″ x 5″ speaker to be mounted on the top of the receiver cabinet by the more enterprising builder.

The remaining triode section of the 6AW8A is incorporated as the S-meter amplifier. It must really amplify too, as the S-meter calibration goes up to 90 db above S9! The meter is disabled in the CW-SSB mode to prevent the needle from pegging and otherwise flopping around unnecessarily.

An unusual, useful, and welcome feature, especially for a receiver in this price category, is the inclusion of a crystal controlled calibration oscillator. With the oscillator (the triode section of the 6AZ8) operating at the crystal frequency of 3.5 mc, fundamental and even harmonic signals are injected into the local oscillator to produce band edge calibration points at 3.5, 7.0, 14.0, 21.0, and 28.0 mc. For 6 meters, an odd harmonic must be used, and is heard at 52.5 mc. The Calibration Reset control on the front panel is a variable capacitor paralleled with the Main Tuning variable.

The power supply is transformer operated, thereby safely isolating the chassis from the ac line, and has silicon diode rectifiers.





Provisions are made for transmitter control and antenna changeover hook-ups via auxiliary contacts on the function switch. When placed in the standby position, two pair of terminals on the rear chassis apron are shorted, providing switch action.

Two manuals are furnished with the SX-140K; one is the assembly manual and may be discarded upon completion of the kit, and the other is an operation and service manual. Keeping these two items under separate cover is a good idea . . . would like to see some other kit manufacturers do the same.

All said and done, the authors are very impressed with this little receiver, both in design and performance. Sensitivity and especially selectivity appear to be well above average for receivers of this type. In short, it would be hard to find a comparable receiver at this price, particularly with 6 meter band coverage to boot. It is also interesting to note that, checking the current used equipment price lists, we find that both kit and factory wired models have the same resale value . . . something to keep in mind.

. . . W3UZN . . . W3WTO

SX-140K Specifications

Frequency Coverage	80, 40, 20, 15, 10, 6 meters. (ham bands only)
Tube Complement	6AZ8 rf amplifier/calibration osc. 6U8A local oscillator/mixer 6BA6 *if* amplifier 6T8A detector, ANL, 1st audio 6AW8A audio output/S-meter amplifier
Controls	Main Tuning, Function (Off, Standby, am, cw-SSB), Audio Gain, Band Selector (6 position), rf gain, Selectivity/bfo, ANL(on-off), Calibrator(on-off), Calibration reset, Antenna Trim.
Antenna Impedance	50-75 ohms
Audio Output Impedance	3.2 ohms
Power supply	Transformer operated, silicon diode rectifiers in a doubler circuit.
Power requirements	117 VAC, 50-60 cycles @ 47 watts.
Dimensions	13⅜" wide, 8¼" deep, 7 3/16" high
Weight	13½ pounds
Price (kit)	$104.95
(factory wired and tested)	$124.95

The Amateur's Cape Canaveral

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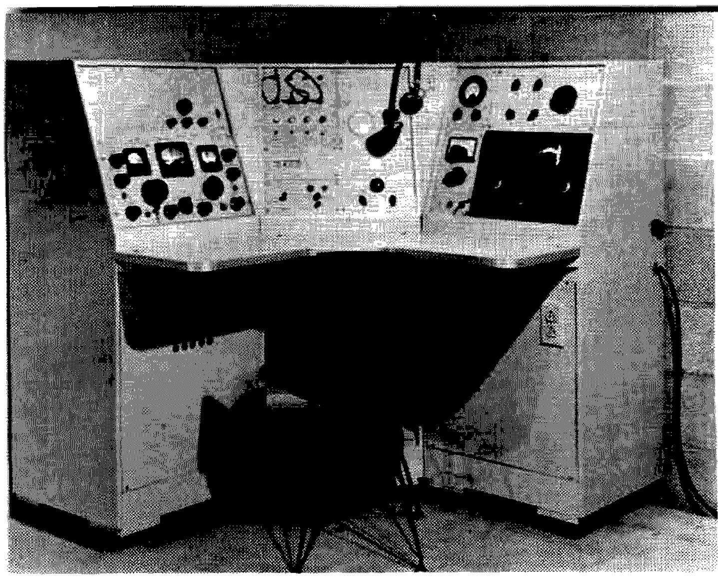
There is probably not an amateur on the subscription list who has not felt pangs of envy at seeing pictures of the electronic installations at Cape Canaveral and other missile places. A few of you readers probably already have installations of parallel quality. Some other few of you will have looked up the prices in a catalog and promptly forgot the whole mess. The rest of you haven't even bothered to look up the prices because you *know* it is too expensive.

Well, fellow hams, take another look and compare with the photographs of what I did for less than twenty dollars!

Since every installation is different there isn't much point in giving exact constructional details. The photographs explain the methods I used and should give you some hints for your console.

The corner console shown in Fig. 1 was made to fit into a space beneath the basement stairs only 4½ feet wide. It has two sloping front sections with nineteen inch rack width each and a center section with seventeen inch rack width. This is not standard but it enabled the console to be fitted into the available space.

Each of the three sections was made from



half-inch interior plywood. The table height is thirty inches and the console height is forty-nine inches measured from the floor. The two triangular wedge panels were cut to fit from ⅛th inch masonite. Two five-sided top pieces fill the space between the rack sections and are detachable so the entire console can be "unhinged" after the table top is removed. This enables the console to be pulled through a standard doorway. (See Fig. 2.)

Each of the sections is eighteen inches from front to back and the pitch of the sloped front is six in seventeen which gives a top depth of twelve inches when the slope starts at two inches above the table top.

Fig. 3 shows my SX 28A receiver mounted on the left, being of standard rack width. The transmitter, a Viking Challenger, is not of standard rack width and merely sits in place on its own rubber feet. A wood block behind it keeps it from sliding out of position.

The other panels were made from sheet aluminum. The mounting hole spacing in all panels is a multiple of one inch, and threaded holes in angle iron supports behind the panels are also spaced every inch so that any panel will fit in any position. This takes care of any rearranging of components at some later date.

The base of the receiver section serves as a speaker enclosure. The bases of the other two sections would make good locations for power supplies and for gear that doesn't have to be touched while operating—converters, modulators, etc. Or, it can be used for a foot rest, like my center section.

Also in the left hand section is a Q Multiplier and 100kc standard. The right section holds an all-band antenna coupler, VSWR meter, 6 Meter vfo, and plug panel for key jack, auxiliary mike, and vfo output plug.

The center panel houses an antenna patch panel, a power distribution panel for controlling vfo, push-to-talk switch, and antenna rotator controls and indicators. Also in the center panel is a Panadapter in its first stage of construction.

The console has been in operation for about four years and has proved to be very versatile in spite of its outward finished appearance that seems to say "this is the final design. Do not add as much as one more knob." Adding new components, however, has been very easy and general wiring changes have been done with complete freedom since the entire console can be pushed out of the small operating room and into the workshop where access is free, tools handy, and the lighting better.

Once you get your console started you will face many decisions concerning the best way to achieve an effective arrangement of components, cabling, and controls. Let me pass on a number of suggestions and solutions that I have learned by experience. Maybe these hints will be just what you need or maybe they will spark an idea even better.

Construction

The console pictured was made from ½ inch plywood, AD interior grade. I used plenty of glue and a few screws at important joints. Other joints received only glue and finish nails. Finish your cabinets with several coats of shellac with plenty of sanding between coats. The first three coats of shellac are the most important to tame the wild grain of fir plywood. For goodness sake do not spoil your console by staining it brown. You should be trying to simulate a $1000 metal cabinet, not an antique hutch cupboard.

Mount each section on caster wheels and pay attention to load ratings when you buy them. Electronic gear is heavy!

The actual shape of your console must be a product of its environment. Remember, though, that a curved console such as mine is easier to operate from than a console with everything in a straight row. No switch or knob on my panels is farther away than a comfortable arm's reach.

Plan now for expansion later. This alone suggests that your panels should be modular widths so that they can be arranged in different ways to suit your amateur fancy. Even in my limited size radio room I can still double the available panel space by placing another tier of panels above the present ones, but tipped forward instead of back. When the time comes, some of the little-used controls can be shifted up and the operating controls shifted down.

Mounting of your commercial gear can be done in several ways:

a. Standard Rack Panels.

Some manufacturers still build their gear to fit a standard rack but be careful of TVI and receiver radiation if you take things out of their boxes. My SX28A seems to perform just as well out of the cabinet as it did in. It has an enclosed rf compartment and a full bottom plate, however. Most present day receivers lack both of these features and may suffer from signal entry directly into the chassis if they are taken out of their shielding cabinets.

b. As is mounting.

Some commercial gear can be mounted into your console and still look as if it belongs there. My transmitter is mounted this way merely by placing it in position and holding it there with a wood block behind it. Other panels around the transmitter make it appear to blend in. Be careful when you build your console that you allow enough room to slide your gear in without scraping. Some of the Heath gear, for instance, measures 19¼ inches over-all width. If the sides are perforated for heat transfer, allow some extra width for air flow.

c. Remounting on new panels.

I mounted my Heath vfo and Q Multiplier behind console panels by drilling matching holes for the shafts and holding the whole thing together with the shaft nuts and original screws. Then I had to do my own lettering. Generally, it will look better if all your panels are alike in style and color. Some panels may be mounted on the front surface with the console panel sandwiched between the manufacturers panel and equipment cabinet.

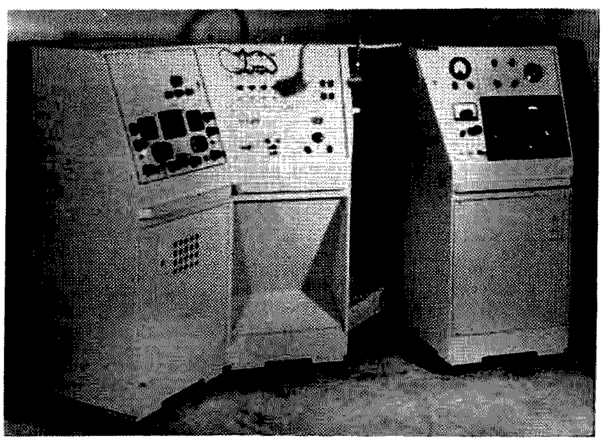
I have placed receiving functions on the left, transmitting functions on the right, and control functions in the center. This arrangement will suit most right-handed people. Left-handers will prefer the reverse.

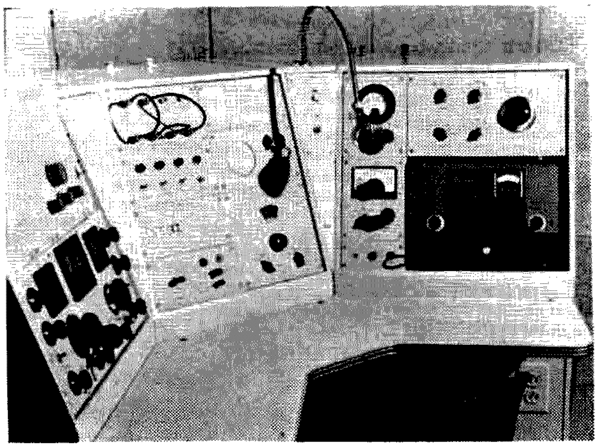
Finishing

My console, like a lot of them at Cape Canaveral, is a soft green color with light grey panels. You may want to match the color scheme of your existing equipment but be careful of dark colors. They can be very tiring to look at after a while.

Buy plenty of paint for the panels. I used a grey spray-can paint but found that the color had been discontinued when I wanted to add a new piece of gear. I consequently bought three cans from the same color lot and painted the entire set of panels over again. Now I have all the present panels painted to match and also have a reserve supply for touch-up and future additions.

Labeling of the panels is a formidable task. There are a number of solutions, however, depending upon how professional you want your





console to appear. A few of these solutions are listed here:

a. Decals. This is the most common solution. However, I have found the quality of the decals available to be rather unreliable. Also, if you spoil one of the decals and find it is the only one of its kind on the sheet, you must try to splice pieces together or buy a new sheet in order to get the one word you want.

b. Wax Transfers. These come by the sheet also. To use these, the sheet is placed over the panel and the word transferred by rubbing on the plastic sheet backing with a blunt stick. The letters transfer to the panel and adhere. An overcoat of clear lacquer is necessary.

c. Rubber Stamp. Several companies make a rubber stamp built like an adjustable date stamp but with a complete alphabet and numeral set on each moveable band. I have used one with six bands and found it adequate. Careful attention to registry and orientation is necessary to get the words on straight. Stamp pad ink is too transparent for most uses on metal panels and doesn't leave sharp edges. A better method is to use black printers ink. Practice on a scrap panel first to learn the "touch." Also keep a rag handy with lighter fluid or solvent to wipe off your mistakes before they dry. This method is also very useful for marking your chassis with tube type designations by each socket. A protective lacquer coat is advisable. These stamps are available through stationery stores for about $10.00.

d. Silkscreen. This process is simple but lengthy and requires a good deal of equipment that most of us do not have. For one-of-a-kind panels it is rarely justifiable.

e. Hand Lettering. Even the steadiest of artist's hands can not letter carefully enough to be acceptable for close observation reading.

f. Machine Lettering. Several types of mechanical lettering guides are available from engineering supply stores, My console panels are lettered this way with India ink.

Electrical: (See Fig. 4)

Main power should be controlled by one easy-to-reach switch. A pilot light is also a wise safety precaution. Each piece of gear should be fused internally and ac power distribution wiring should be fused where the main line comes into the console.

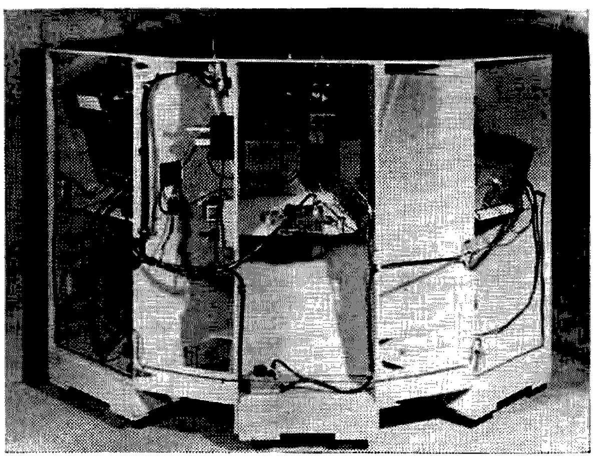
AC power distribution is not difficult. With normal safety precautions and observance of U. L. and local codes, route your ac lines as you wish. A useful item is a strip of appliance outlets in each console section near the top of the console. My console contains a power distribution panel from which I can turn on ac power to converters, relay control circuits, vfo power supplies, etc. Neon indicator lights are very handy. Make at least one ac outlet available from the front of the console for soldering irons, etc.

A good low impedance ground bus is a good idea. I used No. 6 bare copper wire with a series of copper straps soldered at useful points.

Be careful of long coax runs that may turn out to be undesirable fractions of a wavelength. Normal tehniques still apply for determining how long your feed lines should be but be careful to include the lengths of feed line you may install in the console. It is a good idea to measure each critical piece as it is installed because you may not be able to measure it accurately after it is installed!

Install your digital clock in a panel by removing it from its case and taking out the plastic window. The number wheels can then be set from the front of the console, Remember to put the clock on the supply side of the main power switch unless you want to reset the clock every time you operate.

Switching of rf can be accomplished with rotary coax switches which occupy valuable panel space, or by a patch panel arrangement. My installation uses bnc connectors and several



short patch cords so I can rapidly patch from one antenna to another, to dummy load, to converter, or directly to the tr switch. Patch panels are versatile in combining several modes of operation without the expense and confinement of switches.

I cabled all my wiring with Nylon lacing and you will find it well worth the time and expense to get rid of the snarl of wires otherwise a part of every installation. There are a number of substitutes that would do the same job and not be so permanent. The plastic coil-cord wrapping seems particularly adaptable to a changing amateur's needs.

A handful of cable clamps screwed in convenient places will train your cables from one compartment to another. I even cut some holes in the console walls in the interest of shortening up my vfo leads.

Make wiring diagrams of every piece of gear you install. These diagrams should be labeled with wire numbers for all interconnecting cables. These same wire numbers then should be branded on each wire using self-sticking number strips. A twenty-five cent number strip is the best investment you can make in terms of being able to pick out a particular wire in a cable some time later.

I have not attempted to color code all my cable wiring since the wire number system is easier and more versatile.

Generally it is a nuisance to have loose wires on the operating side of the console. My microphone was therefore mounted on a flexible gooseneck from overhead. My key has a cable just long enough to reach the key jack on the panel.

Antenna terminals were provided on the top surface of the console with UHF connectors for coax inputs and two screw terminals for open wire feeders. The main console ground bus is attached to an external ground by a strong spring clip. Connections to the antenna rotator are made through a surplus multi-pin connector. Thus the entire console can be disconnected from its input and output lines with a minimum of disconnections.

Conclusions

Investigation of the catalogs will show that a three section console similar to mine will cost more than $800.00. It will be all metal and precisely made, but it will not go through a doorway and will not provide any more enjoyment than my twenty dollar investment. Hamming doesn't have to be all on-the-air time. And just because my console looks good doesn't mean that it is inefficient either.

So get out the ruler and saw and start *your* console. You will be surprised how much enjoyment it will give you.

. . . K2YIH

Listen . . . Fellow Radio Amateur

Bill Orr W6SAI

Author's Note:

Some time ago Wayne editorialized that he had received practically no correspondence in favor of the Incentive License proposal of the A.R.R.L. Upon writing Wayne that I wished to write on this subject, he graciously permitted the inclusion of this article in 73 magazine. I strongly believe the incentive License proposal is a crucial decision facing radio amateurs. This article gives my reasons for supporting this proposal.

Some time in the future, amateur radio will again face a Moment of Truth at an international gathering whose function will be to examine the radio spectrum with an eye to the future frequency allocations for the various services. At that time the question raised will be: What does the radio amateur contribute to the public welfare, convenience, or necessity that justifies his continued use of important world-wide frequency allocations that are desired by other countries and by other services?

As the question revolves about public interest, convenience, and necessity (commonly called *PICON*), the radio amateur must reply in this context, and with an unprejudiced eye. I propose to do that now. I will speak to you as the Devil's Advocate; that is, I will examine the pessimistic side of the situation, in order to say the thoughts that each one of us keeps buried at the back of his mind. I am going to step on your toes, jab you in the ribs, and give you a poke in the eye with a sharp stick.

No organism grows unless it is irritated, and amateur radio has not been irritated for many, many years. It is going to be irritated to a high degree during the coming years, I assure you.

Let me begin this critical self-examination with reference to Paragraph 78, Article 1 of the International Radio Regulations, Geneva, 1959 which defines amateur radio as:

> "A *service* of self-training, intercommunication, and technical investigations carried on by amateurs; that is, by duly authorized persons interested in radio techniques, solely with

a personal aim, and without pecuniary interest."

Note that the word "hobby" is not used in the definition of amateur radio.

Further, Section 12 of the Federal Communications Commission Rules and Regulations defines amateur radio as:

"A *service* whose purpose is expressed in the following principles . . . a voluntary, non-commercial communications service, particularly with respect to emergency communications . . . a continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art."

This description of the radio amateur service is further clarified by the following . . . "to be brought about by encouragement and improvement of the radio amateur service *through rules which provide for advancing skills* in both the communication and technical phases of the art . . . expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronic experts, and . . . continuation and extension of the amateur's unique ability to enhance international good will . . ."

You will note that in neither the Geneva Regulations nor in the F.C.C. Rules and Regulations is the amateur radio service defined as a hobby. Amateur radio is legally defined as a *service*: just as much a service as the maritime radio service, the Land Mobile Service, or the Fixed, point-to-point service. The idea that amateur radio exists as a hobby is a dangerous one, and a purely amateur concept: to defend amateur radio on the basis of a hobby is, in my mind, a dangerous risk, placing us in an indefensible position that we otherwise would not have to face in the coming years.

The view of amateur radio as a hobby is a widespread and dangerous one, and the fundamental definition of amateur radio as a service has been gradually eclipsed in the past few years in a mass exodus to the hobby concept. Where, may I ask do certificates, round tables, DX-chasing, or other operating pleasures fit within the concept of PICON? Could we be mistaking the pleasant trappings of hobby-ism for the real pursuit of amateur radio?

To examine this fundamental difference of viewpoint, let us look backwards a few years in order to ascertain from what position amateur radio has grown, and from that position observe the state the amateur service has now reached. The pre-World War II year of 1940 is a good starting point, as it signifies a distinct break with a way of life.

The 1940 radio amateur constructed a good deal of his equipment. His ability to talk—to have a QSO—was the successful and only reliable test of his station and equipment. In those days before propagation predictions were generally available, a vast fund of intuitive knowledge was gathered by virtue of DX contests and long distance QSO's to further the new art of propagation prediction. "Long path" openings were first exploited on 14 megacycles by radio amateurs in pre-war days. Further, radio amateurs led the way in expansion of the VHF field. Commercial VHF gear was patterned after amateur equipment.

The 1940 amateur radio license (particularly the old class A license) implied a high degree of manual skill and technical knowledge in the holder thereof. *Thinking* and *doing* were essential, and the radio amateur absorbed knowledge in the process of getting on the air and making contacts. True, the level of knowledge was low compared to today, but the level of mastery was high. The 1940 amateur achieved, in the broad sense, the mastery of his subject matter to the state-of-the-art level. The state-of-the-art was the pride of the radio ham.

Since 1940, however, mighty forces have been set adrift and we are living in a vastly complicated world of change. We have microwaves, lasers, back-scatter, space communications, single sideband and other sophisticated concepts thrust upon us. The advent of television obsoleted the breadboard transmitter, and today's ham rig is wrapped in an r.f. enclosure that is hardly capable of being made on the kitchen table with a Boy Scout knife. In truth, we now find the radio amateur state-of-the-art approaching the graduate engineering level. If the definition of amateur radio as a hobby is true, should the radio amateur attempt to master this high state-of-the-art?

Perhaps to answer this pointed question, we should look about us today. The 1963 radio amateur now buys almost all his equipment. What amateur builds his receiver today? For that matter, who builds his own transmitter? Or, to be more specific, who modifies his factory-built transmitter? Watch out—a modification may spoil the trade-in value! Alas, what has happened to the thinking and doing aspect of amateur radio?

A good friend of mine owns a radio distributing store specializing in sale and repair of amateur radio communications equipment. You would be amazed at the stories he can tell of hams who bring in their gear to be repaired. "My receiver won't work properly," says the disgruntled owner. Opening the lid, the serviceman finds a burned-out tube, a blown fuse, or other obvious trouble. "Today's amateur doesn't even bother to read the instruction book," says my friend. "He's too eager to get on the air and chatter in a round-table Que-so!"

Suppose we look for a moment at today's "reservoir of trained operators, technicians, and electronics experts." A pool of trained operators (communicators, that is, adept in all modes of communication) is certainly a comforting thought and right in line with *PICON* concepts. Yet, today's communicators have been diluted in a sea of confusion. We have several phonetic alphabets, and common procedures and techniques are forfeited to outright rudeness and ignorance.

"Break . . . break"

"Gimme a clear channel for phone patch traffic"

CW operating skill is being subordinated to contest-style operation, and a skilled traffic-operator is vanishing like the Dodo Bird. Phone operation, with the exception of a small public service function of questionable value, does not contribute one whit to the requirements of *PICON*.

As to the "pool of trained technicians and skilled electronic experts"—it is obvious that such a group of radio amateurs—if they really exist—is indeed valuable and a contribution to *PICON*. These amateurs are the living potential for tomorrow's growth in amateur radio, and in engineering, technology and allied arts. This group can contribute to unique areas of research and development that are in the interest of amateur radio and the public.

How fares this "reservoir of trained technicians

and skilled electronic experts?" Judging from the words of the radio store owner—not so hot! Others agree!

A well-known West Coast educator, who is also a radio amateur, has this to say:

"Young radio amateurs, in general, are among the poorer students in engineering and technology. They have the assumption they do not need the basic theory of engineering. They question the worth of the mathematical approach, relying instead on hit-or-miss work. In general, they have no desire to learn basic circuitry. They exhibit a lack of original thinking, and slavishly follow the ideas of others. They cannot analyze a problem, nor do they know the order of magnitude of results to expect."

A sad commentary on today's "reservoir of trained technicians."

A well-known engineer, who is a radio amateur and a project director in a large electronics firm, has this to say about the "reservoir of skilled electronic experts":

"Twenty years ago when a radio amateur came to our organization for employment, his amateur license was prima facie evidence that he was a technician and knew which end of a soldering iron to pick up. He could read a schematic, he was eager to learn, and he had the capability of technical growth. Today, although the electronic industry is crying for trained technicians and engineers, by and large, they are not coming from the ranks of the radio amateur. Possession of today's radio amateur license does not mean that the holder is technically qualified in any sense of the word. The level of skill of the majority of today's radio amateurs, generally speaking, is not high enough for even proper maintenance and operation of commercial or military electronic equipment. Openings are continually available for competent people. It would be nice if they were radio hams."

A sad commentary on today's "reservoir of skilled electronic experts."

These remarks are not unique, and they are symptomatic of amateur radio today. It may be overly pessimistic, but it looks to me as if the fundamental basis of a radio service has been eclipsed in amateur radio in a mass exodus to the level of the hobbyist.

Now, the radio amateur stands today in a naked and exposed position. He has abdicated his natural curiosity in electronics and basic communications and has substituted a superficial desire to chatter. The hobby aspect of amateur radio has stripped today's ham of even a rudiment of technical know-how.

Regardless of the complexity of today's communications, there exists a minimum body of knowledge that must be known by the up-to-date radio amateur. This body of knowledge continually increases, as the state-of-the-art increases. Unless the radio amateur keeps abreast of this body of knowledge, he really cannot justify his existence in the eyes of *PICON*.

Those radio amateurs who do not keep abreast of conventional knowledge and who thereby do not justify their existence are called "appliance operators" by many.

The appliance operator has the same technical grasp of electronics as the housewife who dumps a load of dirty clothes in the automatic washer

and presses the "on" button. And like the housewife, when the washing machine breaks down, the appliance operator calls the serviceman!

I believe, to our shameful detriment, the true radio amateur is rapidly being drowned in a sea of appliance operators. This new species of non-radio amateur is a talker par-excellence. He collects certificates, joins the local radio club, joins round-tables, earns awards and is certainly in evidence on all the bands. If nothing else, he is certainly vocal. Unfortunately, his real technical knowledge is nil, his interest in the service aspect of amateur radio is nil, and he exists only to enjoy his own chatter.

The appliance operator looks upon amateur radio as a hobby—an emotional release from the cares of the day, involving little or no technical skill or understanding, and little intellectual involvement. He does not view amateur radio as a vehicle for advancing the state-of-the-art or satisfying *PICON*, but as his own personal hobby. He has a party-line telephone to the world!

Now: this appliance operator has a grim, vested interest in his hobby and he exhibits a determined desire to cling to his great, electronic toy. Why?

First, he achieves a degree of status in his community of friends by the mere fact of owning and operating complex gear in his home. Possession of complex equipment is thus equated into knowledgeable use of the equipment.

Then, too, by the expenditure of money (ten percent down), any Mister Milquetoast can become a loud voice on the ham bands. Unfortunately, opinionative and often uninformed appliance operators find amateur radio an excellent outlet for their frustrations. Tune in any day and listen to the self-styled experts solve all problems!

Also, the appliance operator enjoys the homey, person-to-person social aspect of the hobby. Clubby meetings, a little intrigue, round-tables, contests, certificates of false achievements, DX-peditions: all provide a romantic thrill and sense of well-being and an emotional release from daily monotony. Why worry about *PICON?*

In addition, the appliance operator enjoys an equality of all on a first-name basis. He can "exchange handles" with the scientist and the senator. He is as good a ham as the next fellow.

This may be fun, but in my opinion, it is not the basis of amateur radio, nor can the hobby aspect justify, on an international basis, the use and occupancy of valuable frequency bands coveted by other nations and by other services. These aspects of ham radio do not tie in with either the Geneva or the F.C.C. definition of amateur radio. The unnatural stress and inflated importance placed on the hobby aspect: contests, certificates, and chattter—by the appliance operator literally submerges the service aspect of amateur radio and reduces us to impotence and frustration. A continuation of this blather will soon result in QST and other amateur radio publications being reduced to historical journals, dealing with past victories of the hobby of amateur radio.

As things are going now, the place of the appliance operator really belongs in the Citizens Band. To be brutally frank, the hobbyist: the appliance operator, emulate to the highest degree the hopes and aspirations of the Citizens Bander. Yes, you, the appliance operator represent the final goal of the Citizens Bander. He yearns to be you!

Yes, the division line between the CB jockey and the appliance operator is a thin one, indeed. And there are close to a half million CB'ers. Two minds but with a single toy to play with!

It would seem, therefore, that a purely hobby-style philosophy of amateur radio is a dangerous view and cannot justify the retention of valuable radio frequencies in the amateur service in view of the pressures that will be placed upon us by other countries and services. What is to be gained for amateur radio by Citizens-Band style of operation beyond the self-satisfaction brought about by the ego-inflating sound of one's own voice? Here, indeed, is our dilemma.

There is no doubt that the hobby aspect (the communication aspect) of amateur radio delivers a great deal of comfort and enjoyment to amateurs who couldn't care less about the more important service connotations of amateur radio. The idea that ham radio is a hobby and every ham is free to pursue his hobby is a widespread and simple belief. The appliance operator, adamant in his vested interest in the status-quo refuses to acknowledge that amateur radio is more than a hobby. The fact is that amateur radio cannot justify the luxury of self-styled hobbyists subordinating the PICON service definitions for his selfish interest in hobby-time chatter.

Observe the hue and cry raised throughout the land over the simple proposal of Incentive Licensing! The appliance operator shouts, "You can't take my rights away from me." Listen, radio amateur: we do not posses "rights"! Amateur radio is a *service* and we enjoy a privilege granted to us on an international basis that may be taken away by a majority vote of nations, many of whom could care less about the amateur service!

The serious radio amateur listens in amazement as he hears arguments against a philosophy of self-education and self-improvement. He is chagrined as he hears the radio amateur service debased and degraded by a flood of chatterers who have no concept of the true meanings and deep traditions of amateur radio. This is a sorry spectacle, indeed. The Incentive License Proposal, actually, is only one important point in establishing amateur radio as a true service. All other services have strict disciplinary structures; why not amateur radio? What excuse do we have for mail-order-style licenses? Do we not all join other services, and all use the same electronic gear and the same ionosphere? A good case may be made that the radio amateur examination be raised to a technical level equal to the radio telegraph or radio telephone first class licenses. Why not?

On the other hand, those who insist amateur radio is only a hobby could very well hold the opposite view: reduce the code exam to the minimum allowed under the Geneva convention and open the gates to everybody. After all, you don't have to have a license to be a stamp collector!

So the all-important question that I submit to you is this: Is amateur radio a service, or is it a hobby? Once this question is answered, the answer to the future of amateur radio is self-evident and requires no argument.

I look at the Geneva definition and the F.C.C. definition and I say amateur radio is a service. I also say that, in general, amateur radio is to-

day degenerating into a hobby and does not justify its existence today.

I believe amateur radio must serve PICON in the most literal way, or we are lost. Radio amateurs must advance the state-of-the-art. Those amateurs who cannot advance the state-of-the-art must at least advance with it.

I believe that amateur radio must attract the intellectually and scientifically minded youngster and must provide him with a technical entré into fields of science, and must encourage him, to the best of his ability, to contribute to these fields.

Amateur radio, in short, must be a vehicle of education. We must not "sell short" the beginning Novice by exposing him only to the vices of amateur radio. He must see the virtues as well.

I believe amateur radio must contribute to international good will and understanding between countries. The RST 599 DX-style QSO with a buck for the QSL card holds us up to the contempt of most foreign radio amateurs. We should use our wonderful radio ham spirit and DX-ability for better purposes than this!

I believe the provincial outlook of our amateur radio periodicals must change forthwith. When you read today's ham journals, it would seem that ham radio does not exist outside the U.S.A., except for ersatz DX-peditions. We must achieve an interchange of views with overseas amateurs and must introduce the new I.T.U. nations to amateur radio, if possible. Perhaps this may be accomplished by amateur radio through the Peace Corps. Life must once again be breathed into the International Amateur Radio Union. We must speak to overseas amateurs in their own tongue. How many of us could hold a QSO in Spanish, French, or Russian? How can we gain the respect and good will of people if we can't speak their language? The immense good will power of amateur radio lies quiet in our hand and we must avail ourselves of this power immediately.

Moreover, I believe these additional questions must be answered: Can amateur radio be of help in advancement of underdeveloped areas of the world? Can amateur radio work with schools and colleges to assist in the education of young people? Why does not amateur radio sponsor a scholarship program to aid worthy, young amateurs who cannot afford a formal scientific education? Why not?

I believe amateur radio has the unique opportunity to enter new and exciting fields of astronomy, mathematics, telemetry, space communications, and propagation. Areas *do* exist wherein the true radio amateur can expand the state-of-the-art. Lasers, upper atmosphere study, Faraday rotation, moonbounce, space location of objects, space satellites, voice to digital conversion, one-way propagation effects, and many other aspects await our interest. I sincerely hope we have this interest.

It is discouraging in the extreme to hear that whenever QST prints a technical article in some advanced field, the League receives a barrage of letters from appliance operators complaining that the article is too technical, and that it takes up space that otherwise could be devoted to contests, DX, operating news, or gossip.

I believe that we stand at the crossroads today, and every indication points to the wrong choice of direction. The appliance operator's emphasis on communication pleasure as his right and hobby will not prove to be a justifiable reason for the continued existence of amateur radio in the years before us. Amateur radio cannot afford the luxury of existing for the appliance operator, without having compensating efforts exerted in *PICON*, or the service aspect. We cannot escape the Day of Judgment, which is fast approaching.

Happily, there is still time left to place our house in order. If we act quickly and properly, we will not have to face the Moment of Truth when we will be found wanting. All is not lost if we recognize what has to be done and if we live up to our responsibilities. The present image of amateur radio as the private hobby of 250,000 individuals, the great majority of whom are oblivious to the *PICON* service aspect, could not possibly stand up under the cold scrutiny of countries who have but a handful of radio amateurs, and who are in need of vital telecommunication frequencies.

Does this all mean that I am proposing that only graduate engineers with a Ph.D. degree should qualify for amateur licenses? Or that all commercially built ham gear should be classified as contraband? Most certainly not! What I am saying to you is that if we use commercially built equipment we should certainly have a good working knowledge of what goes on behind the panel knobs and be able to make a good start at repairing and adjusting the innards ourselves if the gear doesn't work right! Simply stated, we must keep abreast of the state-of-the-art.

There will always be those who lean towards the technical side of amateur radio, just as there are others who find more enjoyment in operating. The latter group, particularly, are the ones who should be searching their consciences to see if they are really contributing to *PICON*, or merely entertaining themselves with a "hobby" at the expense of a truly great service.

I have no wish or desire to eject any radio amateur out of our ranks. Far from it. We need every amateur we can get: real amateurs, not appliance operators. The latter are Citizens Band material. We should, on the other hand, make an honest effort to raise our technical standards, technique and knowledge to meet state-of-the-art specifications. In addition, we must always remember that *PICON* comes before chatter, not after it!

I say we must wake up! We must realize that there are over 120 countries represented in the International Telecommunications Union and each country has one vote, the United States included. Over thirty new nations have recently been added to the I.T.U., since the last radio conference in 1959, and many of these countries do not even have the necessary high frequency channels necessary to conduct their own internal affairs, let alone conduct international communications. They gaze with envy and a cold eye upon our amateur bands, chock full of chatter and nonsense. Ask yourself: what possible interest could these countries possibly have in the reservation of over *ten percent* of the high frequency spectrum for the exclusive enjoyment of a group of hobbyists, playing with communications as if it were a toy, or a party telephone, dabbling with contests and certificates at a buck a throw?

We must provide the U.S. Delegation to the I.T.U. with sufficient ammunition to protect us!

Amateur radio must live up to *PICON* and the Geneva definition. It must provide, at a bare minimum, some means of self-advancement and incentive for the radio amateur to prove his worth and to justify his existence. The proposed Incentive License Proposal is a specific case in point. It amazes me to see such a worthwhile proposal, designed for the betterment of amateur radio, meet with so much emotional opposition—and from individuals that should know better!

In my opinion, amateur radio has the choice of either progressing forward, in step with the advancing art of communications—in the true definition of *PICON*—or of gradually disintegrating into a lowly form of Citizens Radio, in the worst sense of the word, restricted to narrow frequency bands. I fervently hope it will do the former, and I am encouraged that so many amateurs take this long-range attitude. We must raise our sights and embark on a program of self-improvement. One logical step—and I believe others must follow—is the creation of an Incentive Grade License. We stand in a morally defenseless position without this. The shoe may pinch a bit at first, but the disadvantages and risks we run by doing nothing are more than those run by taking decisive action to improve ourselves.

Let us hope, then, that if we take the correct turn at the crossroads, following the path through this forest of diverse interests, we will soon arrive on the broad, sunny uplands wherein the communications operator can occupy his correct place in this wonderful amateur radio service we all enjoy so much, and which is capable of so much good.

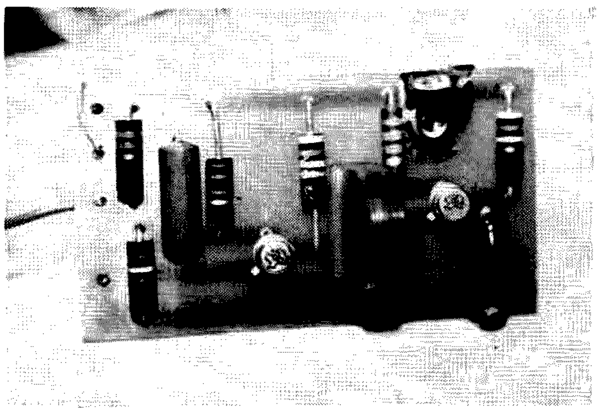
These pursuits which reflect the hobby aspect of amateur radio, when viewed in the proper perspective, are well and good. In the proper degree, these enthusiasts—the so-called appliance operators—will in actuality disappear and true amateur radio operators and enthusiasts will be found in their place, joining the estate of amateur radio, growing with it in stature as the art progresses.

Let us face this pressing problem. The answer must come, and it will determine our fate. The time is short. The American Radio Relay League asks your hand and heart in a vote of confidence. I say, cast a vote for amateur radio!

. . . W6SAI

Communicator IV BFO

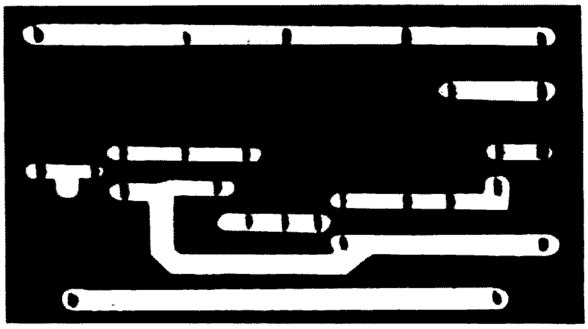
Ronald Vaceluke W9SEK
Buckhorn Ranch Trailer Park
Lot B-39
Des Plaines, Illinois



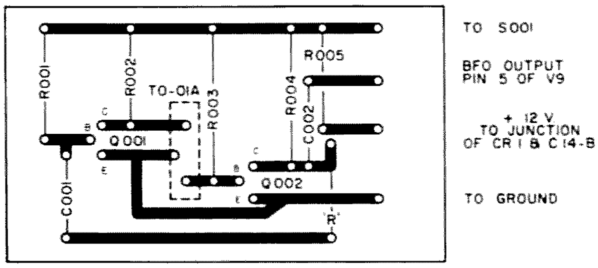
Transfilter TO-01A shown between the two transisters

The "stock" model Communicator IV as manufactured by Gonset leaves few things to be desired in a package VHF unit. However, the need for CW provisions became apparent at the Syracuse VHF roundup when W2WZR replied to my CQ on CW (Jim refuses to use AM!). Oh, sure, I could copy him by setting the threshold point on the squelch and letting him break through the noise, but this is a crude way of doing things. It can be done with a strong signal, but when the signal level is down this method is useless. What is needed then is a BFO and of course, since we want to be able to reciprocate and squirt CW back to the other end, we need a key jack to plug the old J-38 into and a few more odds and ends. The odds and ends for receiving are a BFO, and rf gain control. As for transmitting, a key jack and AM/CW switch. Since the audio circuit is common to both transmitting and receiving it has to be switched automatically, this means the addition of a relay.

Now comes the hard part; where to put all the modifications without damaging the resale value of the unit. Close examination of the rig will show that the mode switch, key jack and rf gain control can be added without changing either the front panel or rear apron. Just below the VFO control jack on the rear of the unit is a spare D shaped hole for an optional variable capacitor. By filing a flat on



the threads of a phone jack, we have a very usable key jack. Now to attack the front panel with a gain control and mode switch. The rf gain is easy if we use a concentric shaft control in place of the audio gain. By using this method we have an audio gain and rf gain control with two knobs where there was only one. How about the mode switch? Hmmm . . . say, how often do you turn the dial lamps on and off? That's good because this now will serve a different purpose. Remove the two leads on the lamp switch, solder them together and insulate. The switch is a spst unit and must be changed to a dpdt. There are two ways of doing this. The first is by removing the front panel and drilling out the rivets that hold the switch, inserting a new one, and fastening it into place with small screws. The second and easiest method (my way) is to merely change the working



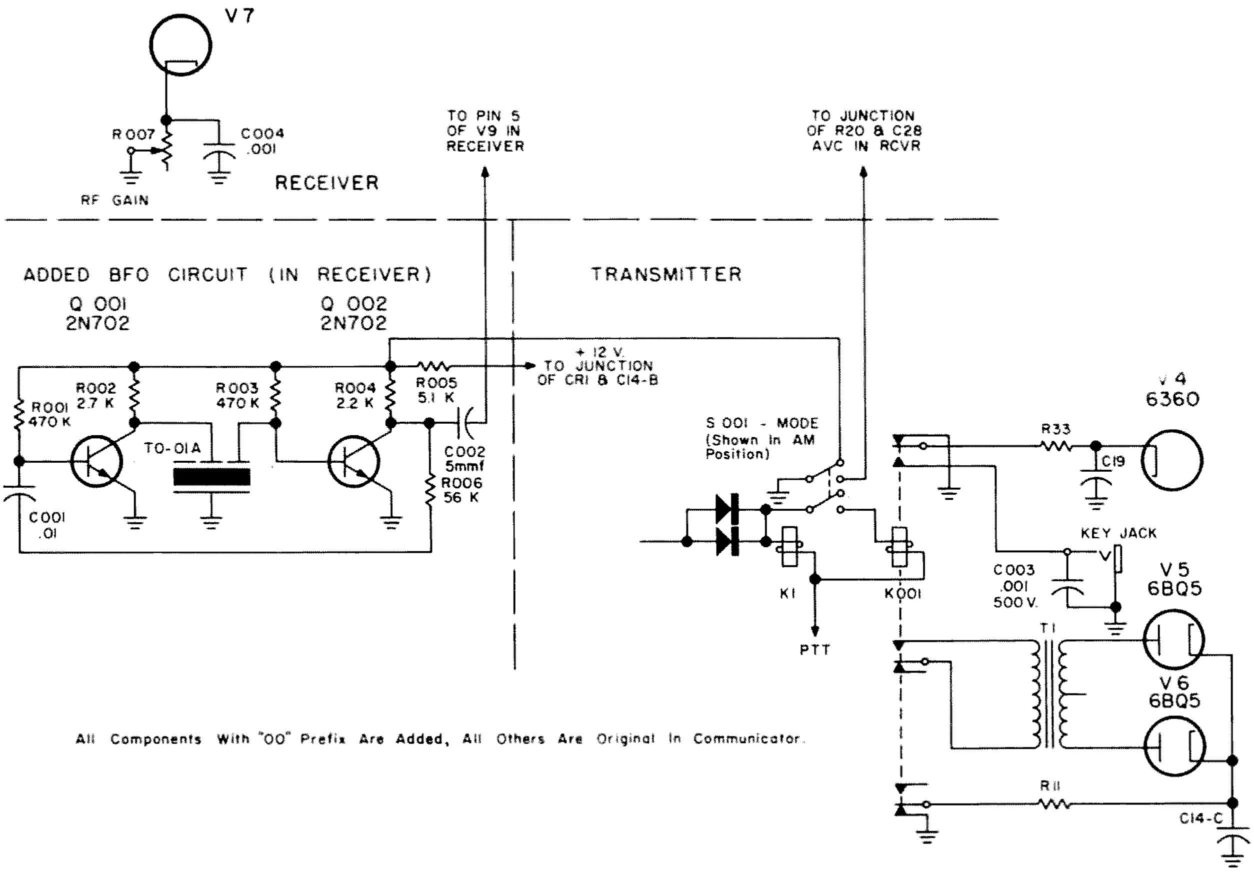
parts. This is done by carefully raising the four tabs that hold down the bakelite insulation; removing the innards, replacing them with new parts from a dpdt unit, and then bending the tabs back down. It takes longer to describe it than to do it.

The mode switch performs the following functions:

CW—Put RY 001 in the circuit; Ground the AVC line; Turn the BFO on.

AM—Remove RY 001 from the circuit; Restore the AVC line; Turn the BFO off.

The relay is mounted next. The one I used came from a friend's junk-box and was originally a surplus unit but any small 3 or 4 pdt contact arrangement can be used. I mounted my relay under the main chassis next to the receiver with a small bracket by drilling several small holes in the chassis to accommodate this bracket. The relay mounting and placement will depend upon the size of the unit you use but it is not critical. The relay oper-



ates only on transmit and only when the mode switch is in the CW position. The function of this relay is as follows:

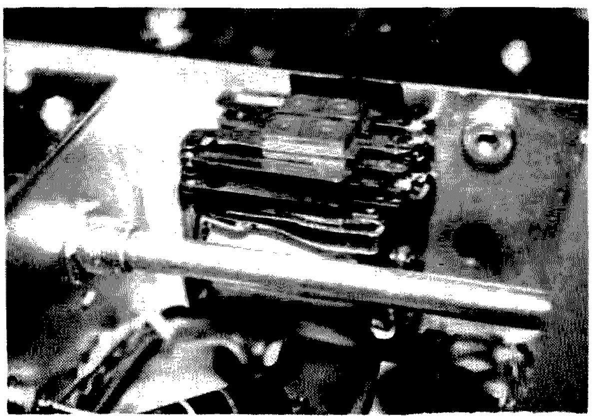
Transmit: Short the secondary of the modulation transformer; Lift the cathode lead of the modulator/audio output tubes from ground; Put the key jack in cathode lead of the 6360.

Receive: Remove the short from the modulation transformer. Restore the cathode lead to audio tubes. Restore the cathode lead of the 6360 to the normal switching line.

Since the Communicator parts list does not give the current rating of the relay rectifier, I was not sure if it could handle too much additional load current. Therefore, I merely added another silicon rectifier in parallel with the original—any diode that can handle 15 to 20 volts at ½ amp or more can be used.

When keying the rig was first tried, the signal was a bit chirpy due to the poor power supply regulation which affected the oscillator screen voltage. This was quickly remedied by the use of a zener diode connected from the screen (pin 1) of V1 to ground. This method is quick and simple and provides a good note on CW.

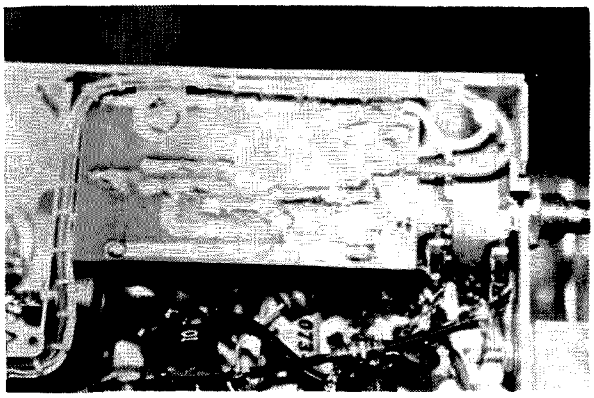
Modifying the receiver takes a little longer



Relay KOO1 fastened to the side of xmitter chassis

than modifying the transmitter but it is not very difficult.

There are several ways to add a BFO, however I believe that the most practical approach is a transistorized unit. Transistors were chosen because of their small size and most important, their lower power consumption. After looking at several schematics of free running oscillators, a recent magazine article[1] caught my eye. The oscillator as originally described used two PNP transistors. These were changed to two 2N702 NPN's that were handy. These can be almost any NPN unit that will oscillate at 455 kc. Construction is not difficult or critical and for those who wish to duplicate my unit, a printed circuit board is shown. If this type of construction is not desired then perforated board and terminals can be substituted.



BFO mounted to the receiver chassis

The BFO can now be tested by connecting 12v as shown in the schematic and connecting the output of the BFO to Pin 5 of V6. Turn the power on and after the rig is warmed up the S-meter should indicate a signal. T_2, T_3 and T_4 should now be aligned for maximum meter reading. This is to insure that the *if* will be on the same frequency as the BFO. The old audio gain control can now be removed and the new dual control added. Leave long leads on the BFO and mount it by means of the ventilating holes in the bottom of the receiver chassis. This placement of the unit will assure that it will be ventilated by convection cooling. After several months of operation, no degeneration of the transistors was experienced due to heat (or anything else for that matter). Now complete all connections as shown in the schematic. All leads concerned with this conversion should now be terminated in a miniature connector and the mating connector should be wired into the main chassis. Remount the receiver and apply the power, putting the new mode switch to CW and the spot switch on. Tune the receiver to the transmitter frequency and listen for the beat note.

It should sound clean. If not, check all connections and both transistors. After the receiver is working properly, plug your key into the key jack and switch to transmit. No output should be indicated on the Communicator's meter until the rig is keyed. Now have your signal checked by another ham or on another VHF receiver in the shack. The note should sound T-9, but if there is excessive chirp check the screen voltage while keying the transmitter. If the voltage swing is more than 2 or 3 volts, the value of the oscillator screen resistor R-2 may have to be lowered to assure "firing" of the zener diode. In my unit this was not necessary.

A cover plate for the new mode switch can be made to dress-up the unit. The original audio knob is drilled thru and will be used as the rf gain and a new knob can be purchased or fabricated on a lathe as mine was.

After several months of use I am quite pleased with the results. Stations have been heard on an aurora opening and with careful tuning SSB stations can be copied.

My thanks to Jerry W9QXP and Art K9TRG for letting me glean parts from their junk boxes. . . . W9SEK

[1] "End of if Transformers? . . . Transfilters!" John Potter Shields, Radio-Electronics, Oct. 1962, Page 41.

Note: Clevite Transfilter available from
Ace Radio Control, Inc.
Box 301
Higginsville, Mo.
Price is $1.25 plus 50c charge for orders less than $3.00

5-7-9

You say you're a contester and don't know when the Goose Bay QSO Party or the PACC CW Contest is? Solve this problem by subscribing to 5 7 9, the only magazine devoted strictly to the fine art of contesting. 5 7 9 publishes monthly listings and complete rules of all contests from small local QSO parties to monstrous DX contests. It also includes the earliest listings of high claimed scores and final results, reaching you only a week after the latest information is received. And cheap, too, only $2.00 per year. Send check, money order, or a roll of nickles to 5 7 9 Magazine, Peterborough, New Hampshire.

Propagation Charts

J. H. Nelson

EASTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7	7	7	7	7	7	7	7	14	14	14	14
ARGENTINA	14	7	7	7	7	7	14	21	21	21	21*	21
AUSTRALIA	14	14	7	7	7	7	7	14	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	14	21	21	21	21	21
ENGLAND	7	7	7	7	7	7	14	14*	14*	14	7	7
HAWAII	14	7	7	7	7	7	7	7	14	21	21	21
INDIA	7	7	7	7	7	7	14	14	14	14	7	7
JAPAN	14	7	7	7	7	7	7	7*	7*	7	7	14
MEXICO	14	7	7	7	7	7	7	14	21	21	21	14
PHILIPPINES	14	7	7	7	7	7	7	7*	7*	7	7	14
PUERTO RICO	7	7	7	7	7	7	14	21	21	14	14	14
SOUTH AFRICA	7	7	7	7	7	14	21	21	21	21	14	14
U S S R	7	7	7	7	7	7	14	14	14	7	7	7

CENTRAL UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7	14	14	14	14
ARGENTINA	14	7	7	7	7	7	14	21	21	21	21*	21
AUSTRALIA	21	14	7	7	7	7	7	7	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	14	21	21	21	21	21
ENGLAND	7	7	7	7	7	7	7	14	14	14	7	7
HAWAII	21	14	7	7	7	7	7	7	14	21	21	21
INDIA	7*	7	7	7	7	7	7	14	14	7	7	7
JAPAN	14	14	7	7	7	7	7	7	7*	7*	7	14*
MEXICO	14	7	7	7	7	7	7	14	14	14*	14*	14
PHILIPPINES	14	14	7	7	7	7	7	7	7*	7*	7	14
PUERTO RICO	14	7	7	7	7	7	14	21	21	21	21	14
SOUTH AFRICA	7*	7	7	7	7	7	14	14	21	21	21	14
U S S R	7	7	7	7	7	7	7*	14	14	7	7	7

WESTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7	7	14	14	14
ARGENTINA	14	14	7	7	7	7	7	14	21	21	21*	21
AUSTRALIA	21	14	14	7	7	7	7	7	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	7	14	21	21	21	21
ENGLAND	7	7	7	7	7	7	7	7*	14	14	7	7
HAWAII	21	14*	14	7	7	7	7	7	14	21	21	21
INDIA	7*	14	7	7	7	7	7	7	7*	7	7*	14
JAPAN	21	14	14	7	7	7	7	7	7	7*	14	14
MEXICO	14	7	7	7	7	7	7	14	14	21	21	14
PHILIPPINES	21	14	14	7	7	7	7	7	7	7*	7	14
PUERTO RICO	14	7	7	7	7	7	7	14	21	21	21	14
SOUTH AFRICA	14	7	7	7	7	7	7	14	21	21	21	14
U S S R	7	7	7	7	7	7	7	7*	14	7*	7	7

* Indicates next higher frequency has a chance of getting through on good days.

Good: 1-4, 17-19, 27-28
Fair: 5, 10-14, 16, 20-23, 25-26
Poor: 6-9, 15, 24, 29-30
Es: 1-5, 16-19, 26-27 (High MUF and/or freak conditions)

Items of Interest

The blackout that came on quite abruptly September 22nd was the most severe of 1963 so far.

The sun was carrying a very large spot at the time about one day past the Central Meridian. A sunspot this size is extremely rare at the present part of the sunspot cycle. With proper eye protection it was visible to the naked eye.

Premium Tubes . . . con't.

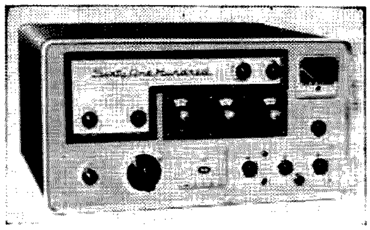
TSgt. William Gardiner
511C F.T.D.
Walker A.F.B., N. Mex.

W4WKM's article on premium tube replacements in the November 73 was most enlightening to those of us who frequent the surplus outlets and have a large supply of "four digit" tubes to prove it. Having long ago decided that such a substitution list was vital, I had compiled my own after much research and head scratching.

After comparing my list with W4WKM's work, I found that there existed some discrepancies between the two. I have carefully gone over my list and re-evaluated the cross reference data. The revised list has a few differences, but these could cause much trouble to anyone trying to substitute where substitution is not practical or technically possible. My own listing is herewith shown along with a few notes showing where differences exist between the premium tube and the tube it replaces. I have added some that were not shown in the original work, plus a few CRT substitutions and crystal diode replacements.

Premium Tube	Prototype
1003	OZ4
1223	6C6
1231	7V7
1258	3C45
1613	6F6
(1613 rated for high frequency operation)	
1613	6K6GT
(6K6GT filament current rating is 43% lower)	
1616	836
(836 output current is 92% higher)	
1620	6J7
1621	6F6
(1621 is rated for high frequency operation)	
1621	6K6GT
(6K6GT filament current rating is 43% lower)	
1633	6SN7GT
(Filament voltage rating of 6SNGT is 75% lower, filament current rating is 300% higher)	
1805P4	5AP4
1899	2F21
5022	4-400A
(5022 plate dissipation rating is 37.5% lower)	
5311	931A
5517	1B48
(1B48 current rating is 50% lower)	
5557	287A
5589	376B
5608	6AG5
(6AG5 filament current rating is 70% higher, plate voltage rating is 100% higher)	
5608	6BC5
(6BC5 filament current rating is 70% higher)	
5648	2C39B
(5648 ratings are 11% higher)	
5655	2P23
5681	930
5691	6SU7GT
5693	6SE7GT
(6SE7GT transconductance is 100% higher, plate current rating is 50% higher)	
5695	866JR
5725	6AS6
(Grid-plate capacitance of 6AS6 is 100% higher, plate and screen dissipation is 11% higher)	
5765	2C37
(5765 has feedback)	
5804	1AK4
(Filament current rating of 1AK4 is 66% lower)	
5823	395A
5824	25L6GT
(5824 plate voltage and current rating is 20% higher)	
5826	2P23
(2P23 has lower sensitivity)	
5852	6X5GT
(6X5GT filament current rating is 50% lower)	
5852	6AX5GT
(Output current rating of 5852 is 95% lower)	
5894A	829B
(Filament current rating of 5894A is 20% lower)	
5897	6K4
(Amplification factor of 6K4 is 26% lower, transconductance is 5% lower, grid-plate capacitance is 57% higher)	
5898	6AD4
5910	1U4
(Grid-plate capacitance of 1U4 is 100% higher)	

73 Tests the



B & W 6100

An incredible amount of design has obviously gone into the B & W 6100 transmitter since it is a radical departure from present day amateur transmitter equipment. The big difference is the tuning system. Instead of the usual one knob for tuning the transmitter VFO, the 6100 uses three and they are so accurate that you can read your frequency directly on them.

This is accomplished by means of a frequency synthesizer, a veritable forest of crystals inside which are switched by the 100 kc control, the 10 kc control and then "rubbered" by the last knob, which is calibrated directly in kilocycles. The megacycles are set by the bandswitch.

The crew at the 73 hamshack were quite impressed by the ease with which you can go to any desired frequency just by setting the dials . . . and you are within 200 cycles, invariably. Needless to say the unit is rock-stable. Another good feature was the extreme ease of tuning up on any band. Once you learn the system you can flip to any frequency on any band and be tuned up in a few seconds. Though fellows don't pay a lot of attention to how ham gear looks, we did notice that the XYL's visiting the station almost always had something nice to say about the 6100. It *is* a beautiful piece of gear, in case you hadn't thought of it.

The 6100 runs 180 watts PEP on sideband and CW, and 90 watts on single sideband AM phone to a pair of 6146's in the final. It has VOX, push-to-talk and manual operation.

The ALC circuit is particularly effective in the 6100. It feeds back voltage to two earlier stages, each with a different time constant (one is .03 seconds to control the gain during syllabic variation, the other 1.5 seconds to control the gain between words), with up to 10 db of voice compression resulting. This can be read on the panel meter in one switch position.

The panel meter also reads the cathode current of the final and the output power.

The power supply uses all silicon diodes, with the result that the 6100 operates noticeably cooler than most transmitters. The input of the rig can be matched to your line voltage from 105-125 volts.

The sideband signal is generated by means of the B & W crystal lattice filter. Filter bandwidth at the 3 db points is 3000 cycles, so voice comes through clear and clean.

The 6100 provides extra contacts on its VOX relay to operate antenna relays, disable the receiver, etc. It also provides -100 volts for possible blocking of your receiver or a linear.

The clickless grid-block keying was very popular with the CW ops in our crew.

The output of the 6100 is designed to match either 52 or 75 ohm coax, though it will tune anything from 30 to 100 ohms with the pi-net. Beyond that it is prudent to use an antenna matching unit. We *always* do.

B & W is to be congratulated on turning out such a good looking, well designed and fine operating transmitter. We enjoyed our tests of this rig very much and there were many groans when the time came for it to go back to B & W.

Now that B & W has broken the ice and proved that it is possible to have a frequency

synthesizer in ham equipment we may find more manufacturers following their lead.

. . . W2NSD/1

Specifications

Frequency coverage: 3.5-4.1 mc, 7-8 mc, 14-15 mc, 21-22 mc, 28-29 mc, and 29-30 mc.
Power Input: 180 watts CW/SSB PEP, 90 watts AM PEP.
Final: 6146's in parallel.
Power supply included.
Price: $875.
Manufacturer: Barker and Williamson, Bristol, Pennsylvania.

Just because the editor of 73 was not invited to the innauguration of the new ARRL Building is no reason to hold back on your subscription to 73. Subscribe immediately and right this grievous wrong.

MASTER ORDER BLANK

73 Subscriptions — Name________ Call______

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Back issues (page 107)______

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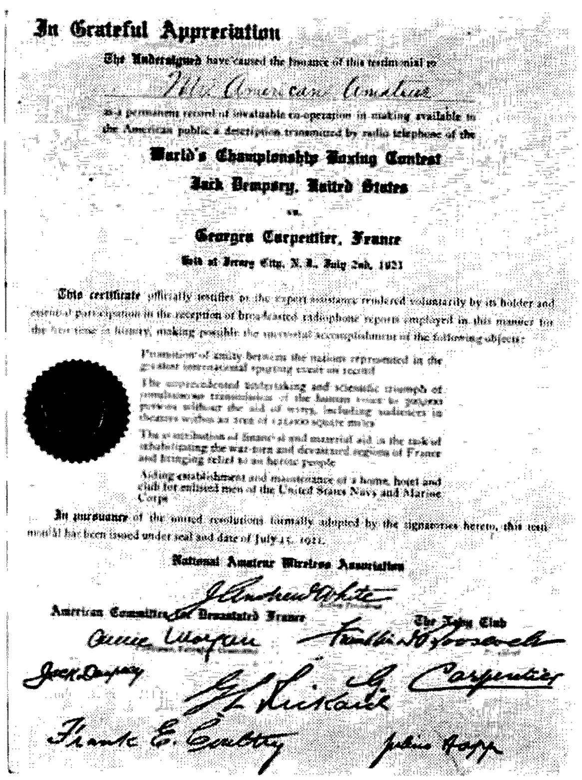
Frank Whitmore W2AAA
223 W. Holly Ave.
Pitman, N. J.

The Battle of the Century

If you enjoy winning awards in Amateur Radio, you'll envy the ol'sters the certificate they earned forty-two years ago. It bears the date of July 2, 1921. Old-timers in the east still talk about that one. It contains the signatures of Franklin Delano Roosevelt shortly after he retired as Assistant Secretary of the Navy; and Jack Dempsey, then heavyweight champion of the world.


In Grateful Appreciation

The Undersigned have caused the issuance of this testimonial to

The American Amateur

as a permanent record of invaluable co-operation in making available to the American public a description transmitted by radio telephone of the

World's Championship Boxing Contest

Jack Dempsey, United States

vs.

Georges Carpentier, France

Held at Jersey City, N. J., July 2nd, 1921

This certificate officially testifies to the expert assistance rendered voluntarily by its holder and [illegible] participation in the reception of broadcasted radiophone reports employed in this manner for the first time in history, making possible the successful accomplishment of the following objects:

Promotion of amity between the nations represented in the greatest international sporting event on record

The unprecedented undertaking and scientific triumph of simultaneous transmission of the human voice to [illegible] persons without the aid of wires, including audiences in theatres within an area of [illegible] square miles

The contribution of financial and material aid in the task of rehabilitating the war-torn and devastated regions of France and bringing relief to its heroic people

Aiding establishment and maintenance of a home, hotel and club for enlisted men of the United States Navy and Marine Corps

In pursuance of the united resolutions formally adopted by the signatories hereto, this testimonial has been issued under seal and date of July 15, 1921.

National Amateur Wireless Association

J. Andrew White

American Committee for Devastated France

Anne Morgan

The Navy Club

Franklin D Roosevelt

Jack Dempsey

G. Carpentier

Frank E. Coultry

Fig. 6 — The certificate issued to Amateurs July 15, 1921 by the National Amateur Wireless Association in grateful appreciation of their expert assistance during the Dempsey-Carpentier heavyweight fight.

With commercial broadcasting non-existent and a public without receivers, the Radio Corporation of America set out to broadcast the forthcoming Jack Dempsey-Georges Carpentier heavyweight championship fight. At the start they possessed only the idea. They needed everything: permission of the fight promoter, a powerful radiotelephone transmitter, and a means for the public to hear. Many in the radio business just laughed at the whole idea. In their opinion the transmitter didn't exist that could cover an area big enough to make the plan worth a try. Others, though the odds loomed large against success, willingly lent their assistance. Hams joined the adventure as soon as they heard.

The event spelled a big success for amateur radio and left a public deeply impressed. For some reason it doesn't appear in QST. Yet the episode taxed the ingenuity of the amateurs to the utmost and required them to do the "impossible." Through the union of the amateurs with the professionals, several hundred thousand sport-lovers from Maine to Florida thrilled to the blow-by-blow description direct from ringside as Jack Dempsey and Georges Carpentier fought the battle of the century for the heavyweight title of the world.

When the call for help went out to the amateurs, hams chatted and experimented on one wavelength—the 200-meter band. Ham calls lacked prefixes. They began with a number followed by a couple of letters. Commercial radio broadcasting didn't exist either. Broadcasting consisted of special programs by some of the amateur stations and the pioneer broadcasts from radio station KDKA in Pittsburgh. Only the amateurs and some experimenters enjoyed these broadcasts; no one else owned receivers. Radio fever didn't strike the public

Fig. 1 — Lost in a sea of fans. A general view of a portion of the 90,000 sport fans that crowded into Boyle's Thirty Acres in Jersey City to watch the Jack Dempsey-Georges Carpentier heavyweight championship fight.

until later that year after the Department of Commerce started issuing regular broadcast licenses in September 1921.

But something did hold the public's interest that spring: the forthcoming heavyweight championship fight between the American champion and the French contender. Interest ran high on both sides of the Atlantic. Sport followers from all over the world planned to attend. In the United States, everyone who could "come-by" a ticket intended to see the fight too. Unfortunately, however, not all could attend. Though Boyle's Thirty Acres in Jersey City, New Jersey, represented the biggest outdoor arena in the world, it could hold only 90,000. Thousands of fans faced disappointment.

At RCA, a corporation just formed two years before, a handful of aggressive men got an idea. If thousands of sport fans couldn't get in to see the fight, maybe they could bring the fight out to them. Hearing a broadcast coming direct from the ringside would provide the multitude of disappointed fans with the next best thing. The RCA men stood nearly alone in their belief that it could be done. How could they persuade the fight promoter, Tex Rickard, to permit the broadcast? Where could they find a radiotelephone transmitter powerful enough to spread the contest over hundreds of miles? And the public! What could a receiverless public use to hear the fight? Surely no group of adventurers faced any blacker conditions.

By the beginning of June, things looked much brighter for the adventurous promoters. By offering the broadcast as a service to charity, they won Tex Rickard's permission for the broadcast. The United States Navy eventually succumbed to a "durability" argument and promised to lend the most powerful radiotelephone transmitter ever built. Now, only the means for the public to hear remained unsolved. For this solution the RCA professionals turned to the amateurs.

The call for help went out to the amateurs on June 10th. Less than a month remained before "fight time." The urgent plea asked the amateurs to convert their receivers to long

waves, add amplifiers and loudspeakers, and install them in public places so large audiences could hear. What a chore! Most hams happily got along with a crystal set splitting earphones occasionally so a guest couldalso hear. To fill an auditorium with sound from a receiver absolutely escaped the imagination of many and eluded the pocketbooks of a great many more.

The notice soliciting the amateurs' help emanated from two sources: The National Amateur Wireless Association and the radio journal, Wireless Age. Both operated from 326 Broadway, New York City. Guillermo Marconi held the position of president of the amateur association with J. Andrew White presiding as acting president. White, in addition, edited the Wireless Age and worked for the Radio Corporation of America.

Wireless Age, a national magazine subscribed to by many amateurs, carried a full page notice of the pending broadcast attempt. This magazine flourished from October 1913 until August 1925. The make-up differed considerably from amateur journals of today: it carried both short paragraphs and page articles concerning commercial radio progress and activities; and, in addition, featured many how-to-do-it articles that the amateur fraternity enjoyed. QST's advertisement showed up regularly in its pages.

The opportunity to assist with the "fight" broadcast reached the hams at an ideal time. Bounced from commercial longwaves down to 200 meters by the Wireless Act of August 13, 1912, the hams generally still held their grievance. Though they realized that only by a hard fight before Congress did amateurs get any wavelength at all, still they longed for the longwaves. Now suddenly an opportunity dropped right into their laps. The invitation

Fig. 4 — The commercial longwave receiver borrowed from Westinghouse by the Springfield Amateur Radio Club to present the Dempsey- Carpentier fight to 10,000 people in Springfield's Court Square.

from the professionals announced a transmitting wavelength of 1600 meters for the broadcast.

Hams rallied to the cause with delight. Several things pleased them about this break. First, of course, relief from the monotony of 200 meters. But two other equally important reasons also stood out both touching on their pride: the special broadcast offered a chance for amateurs to show their mettle; and their services would contribute to a good cause. Under the arrangements between the broadcast promoters and the fight promoters, two charity organizations—The American Committee for Devastated France and the United States Navy Club—would share equally in the proceeds from the broadcast.

During the two months prior to calling upon the amateurs, a tremendous amount of work took place. Preparations for the broadcast split into two parts: technical and business. The National Amateur Wireless Association busied itself finding a suitable transmitter and selecting the transmitter site. Later they organized the amateurs for reception of the broadcast. The American Committee for Devastated France took on the business arrangements. Representatives of this charity organization—headed by Anne Morgan, daughter of the banker J. P. Morgan—contacted theatres, halls and auditoriums in cities and towns within a 200-mile radius of Jersey City. They arranged the details for public presentations and established the admission price.

Finally, with the transmitter obtained, the broadcast site picked, and public places available for listening, the National Amateur Wireless Association directed its attention to the amateurs. "Fight-time" loomed three weeks away! Concentrating their attack on the receiving problem, the association rushed notices to amateurs, amateur clubs, manufacturers, and radio organizations seeking their help. At the same time, the exciting details of the great experiment appeared in the July issue of Wireless Age.

From the start, nearly every amateur wanted to help. Applications poured in. Out of the heap of applications received, the National Amateur Wireless Association selected and assigned the most qualified amateurs to install and operate their equipment in the leased theatres and halls. Those not selected took part in other ways. The association asked them to invite friends and acquaintances into their homes to hear the broadcast and to send contributions collected to the association's New York office. By this invitation, a big sector of the public lying beyond the 200-mile radius of Jersey City also got to share in the charity

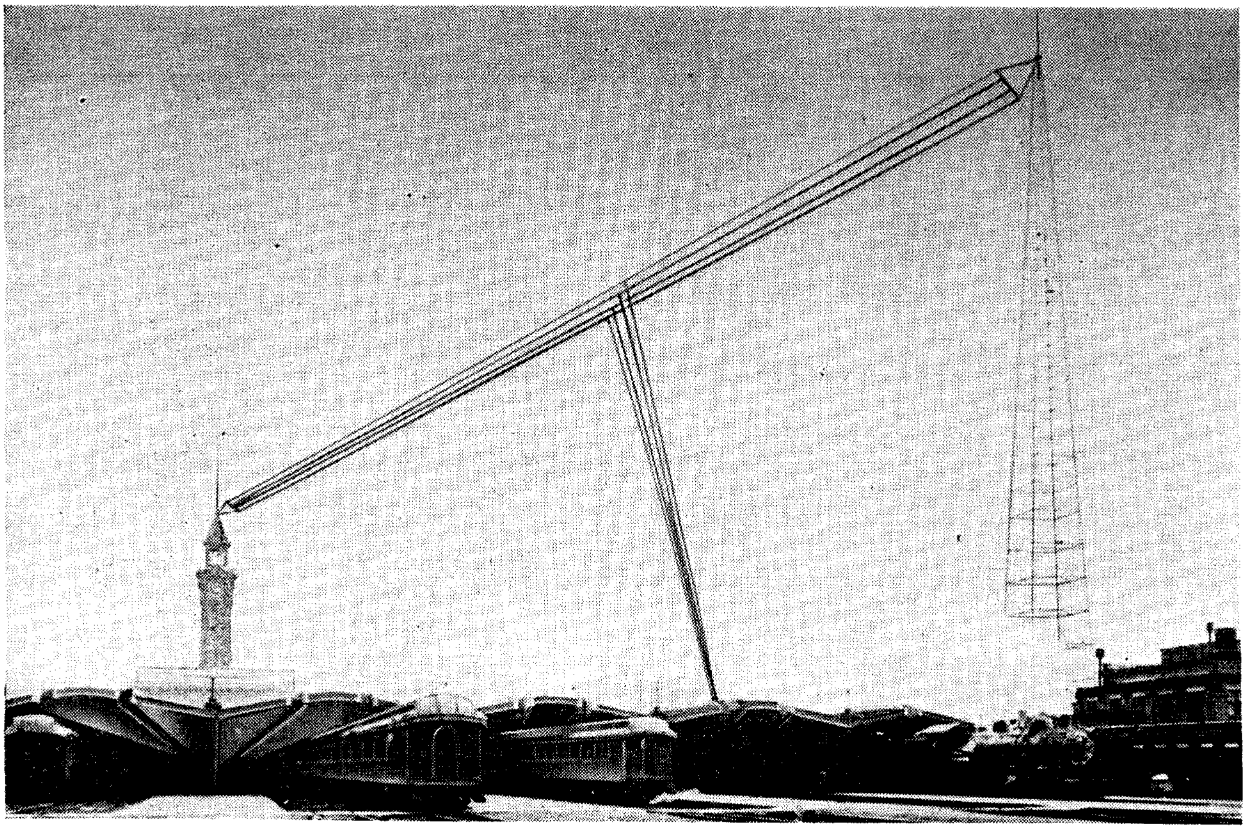


Fig 3 — A view of the multi-wire antenna system erected in the Lackawanna Railroad Terminal in Hoboken, N. J.

drive.

Hams quickly discovered that a big frequency gap separated 200 from 1600 meters. Setting up good 1600-meter installations required plenty of hard work and sweat. But with concentrated effort, skylines in the selected cities and towns changed practically over night. Above the theatres and halls acquired for the presentations, long multi-wire antennas swayed between distant supports. Inside, amateur equipment looked different too. Converted receivers lay burdened beneath large honeycomb loading coils; and two-stage amplifiers strained noticeably in a struggle to feed sufficient volume to multiple loudspeakers. Receiving installations varied from the newest manufactured gear to the latest homebrew innovations. Some boasted superb Magnavox loudspeakers; others operated with homemade adaptations joining dissected headsets to dismantled Victrola horns. Upon such a conglomeration of apparatus the amateurs braved the hazard of satisfying a paying public.

The search by the National Amateur Wireless Association for a suitable transmitter ended at the General Electric Company plant in Schenectady, New York. There, almost ready for shipment to the Navy, sat the most powerful radiotelephone transmitter ever built. Just what they needed!

Not at all backward, the broadcast promoters set out to borrow it. But, did you ever try to borrow something from the Navy? A direct attempt brought a quick, *"no!"* The Navy thought the proposition too sticky and wouldn't cooperate. Refusing to be dissuaded, the promoters approached the problem anew. This time they centered their attack on the Navy's weak spot—dependability. Contacting Franklin D. Roosevelt, the Assistant Secretary of the Navy until just a short time before, the eager promoters sought his help. They maintained that the broadcast would present the severest test the Navy could ever get for this piece of

gear. Their argument apparently impressed Roosevelt, for shortly afterwards, the Navy reversed itself and agreed to lend the transmitter.

The Navy transmitter combined six 250-watt tubes with 2000 volts on the plates for about 750 watts output on voice. Amateurs, used to their flea-power tube rigs, felt awed in the presence of such power. In telephone service, three tubes operated as oscillators and three as modulators. No taboo existed in those days about modulating an oscillator. On CW, a switch connected all six tubes together to work as oscillators for about 1500 watts out. Alternating current from a separate winding on a direct-current motor fed the tube filaments.

To get away from as much interference as possible, the broadcast promoters looked to the longwaves. They finally settled on 1600 meters. Comdr. D. C. Patterson, the District Communications Officer in New York, gave his consent for use of that Navy frequency and assured the promoters the Navy would keep off that channel during the afternoon of the scheduled fight. Arthur Batcheller, Chief Radio Inspector for the New York district, rushed the special license through and secured call letters WJY. To this day, those call letters stir fond memories among the "Gang" who tuned in that epic broadcast.

Originally, the promoters planned to install

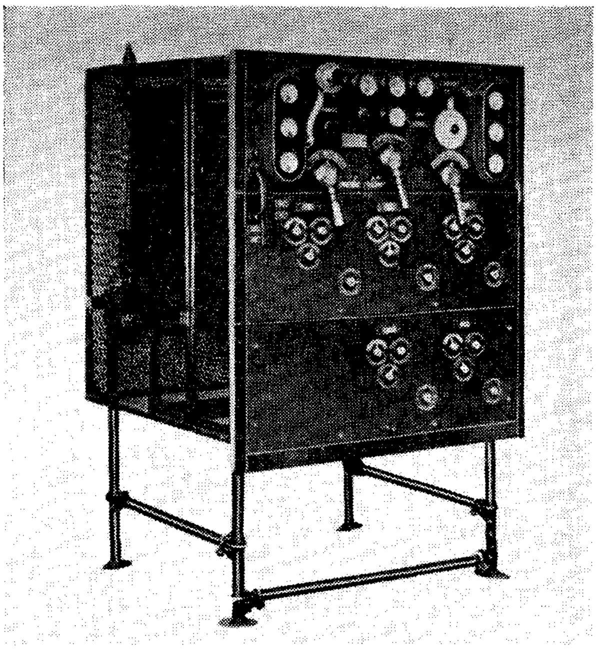


Fig. 2 — The Navy transmitter borrowed by RCA for the Dempsey-Carpentier championship fight. Note the pipe-rack construction typical of switch gear in those days. The transmitter used six 250-watt tubes. On voice, three worked as modulators and three as oscillators. On CW, all six oscillated.

the transmitter right at the ringside. However, after determining the cost for a suitable antenna system, they scrapped the idea. Erection of an adequate antenna system came too high for a project where all proceeds went to charity. However, they found just what they needed practically ready-made at the Lackawanna Railroad terminal in Hoboken, New Jersey. Following the prompt consent of the railroad officials, technicians quickly strung a four-wire T antenna between the four-hundred-foot-high tower in the railroad yard and the clock tower on the terminal building four hundred and fifty feet away. From the center of the antenna, the lead-in dropped down to the transmitter housed in a converted railroad shack used by Pullman porters for changing their clothes. The elaborate ground system consisted of copper roofs of train sheds and other low buildings, the network of railroad tracks, and a system of pipes running into the salt water of the Hudson River. The combination of antenna and ground presented a fundamental period of 750 meters. Telephone lines, stretching over a distance of two miles, connected the transmitter shack with the announcer's booth at ringside.

A week before the fight, tests began. Starting with reduced power, engineers conducted the tests from both the transmitter site and ringside. The tests lasted several hours. Each successive night, hams at their listening posts noticed the signals grow a little stronger as the engineers increased power. Following the broadcast test runs, the promoters checked the telephone reports coming in from the amateurs. On July 1st, the night before the two contestants met, the transmitter engineers turned on full power. Reports from seven states along the Atlantic seaboard poured in tying up eight trunk lines. By nine o'clock all doubts vanished. The excellent reports assured the promoters the fight broadcast the next day would be a success.

The gong clanged for the start of round one! Amateurs from Maine to Florida huddled tensely over make-shift receivers and mopped beads of sweat from their brows. Tense audiences, packed tightly into non-airconditioned theatres and halls, leaned forward to catch every word unmindful of the perspiration wetting their clothes. On the outside, temperatures in some places reached ninety in the shade. And miles away, confined in an 18-foot square, the bodies of Jack Dempsey and Georges Carpentier glistened in the humid atmosphere as they fought the Battle of the Century for the heavyweight championship of the world.

At the Gaiety Theatre in Utica, New York,

George Benas, owner of amateur radio station 8CC, donned earphones and sat before the receiver controls to monitor the broadcast. Benas gained prominence in radio circles by receiving telegraphic messages from foreign countries at his ham station on Elm Street. The J and N Electric Company where he worked, lent the three-tube modern receiver and the four loudspeakers facing the audience. The whole installation sat on the stage just in front of the footlights in full view of the paying public. A lead-in running up to the roof connected to a 250-foot long multi-wire antenna atop the theatre. Robert Evans, a commercial radio operator, stood by on the stage to assist.

J. Andrew White announced the fight from a special booth at the ringside. By drawing upon his early days as a lightweight boxer, he captured realistic flavor as he reported every move of the contestants accurately and quickly. But the radio audience didn't hear White's voice; they heard, instead, the voice of amateur radio operator J. O. Smith. Smith, the well-known operator of amateur station 2ZL, covered the radiotelephone installation for the Radio Corporation of America. Because telephone company restrictions prohibited connection of the special line from ringside direct to the transmitter, Smith, standing by at the transmitter, repeated word-for-word into the microphone White's description as it came in over the telephone line from the arena.

The record breaking crowd at the Gaiety Theatre totaled 790. Many women fans attended too. As the American champion and the lightning-fast Frenchman "mixed it up" in the first round, the crowd applauded and shouted. Finally, Robert Evans stepped to the edge of the stage and cautioned them, "let those at the ringside do the applauding. The

contestants can't hear you and you'll miss some of the fight if you don't remain silent."

Paid audiences in 112 other cities also listened to the realistic fight description pouring from loudspeakers. In New York City, fight fans assembled at ten scattered locations. In a great many places where the charity organization did not contract for halls or theatres, enterprising and enthusiastic amateurs undertook independent affairs of their own. Many took up collections from their listeners and forwarded the money to the charity.

At Asbury Park, N. J., W. Harold Warren using a loop antenna, detector and two step amplifier, enjoyed the fight from a roller chair on the boardwalk. A ham in Jamaica, Long Island, N. Y., received the fight with a 15-foot clothesline antenna and a crystal set. Hams at Stamford, Conn., Fordham and Brooklyn, N. Y., and Allentown and Philadelphia, Pa., coupled megaphones to their earphones and entertained up to 25 people in their homes. An amateur in the Frankford section of Philadelphia, strapped a Victrola horn to his earphones and extended the listening range to 100 feet.

G. C. Brown listened to the broadcast at Eastport, Maine, a distance of 425 miles. At Poultney, Vermont, F. C. Fassett reported the gong between rounds clear and loud and the broadcast reception excellent. Hardwick, Vermont, reported fine reception too. At Donora, Pa.,–350 miles away–listeners enjoyed the fight in temperatures 90 degrees in the shade. Captain C. H. Butchelder of the SS Acropolis enjoyed the fight while 400 miles out at sea. Charles P. Hoyd heard it fine at Salem, Ohio, also 400 miles away. Even Fort Pierce, Florida, reported good reception as did a ship 1800 miles at sea.

But at Springfield, Mass., a young radio club and its group of youngsters pulled the biggest surprise of the whole broadcast. Springfield hosted two amateur groups; The Connecticut Valley Radio Club and the Springfield Amateur Radio Club. The older, more experienced hams belonged to the Connecticut Valley Club, while a group of teenagers made up the other one. Naturally, a little rivalry existed –especially on the part of the youths.

By arrangements with representatives of the American Committee for Devastated France, the Connecticut Valley Club handled all technical activities for the public presentation of the broadcast at the Plaza Theatre in Springfield. This left the young group completely

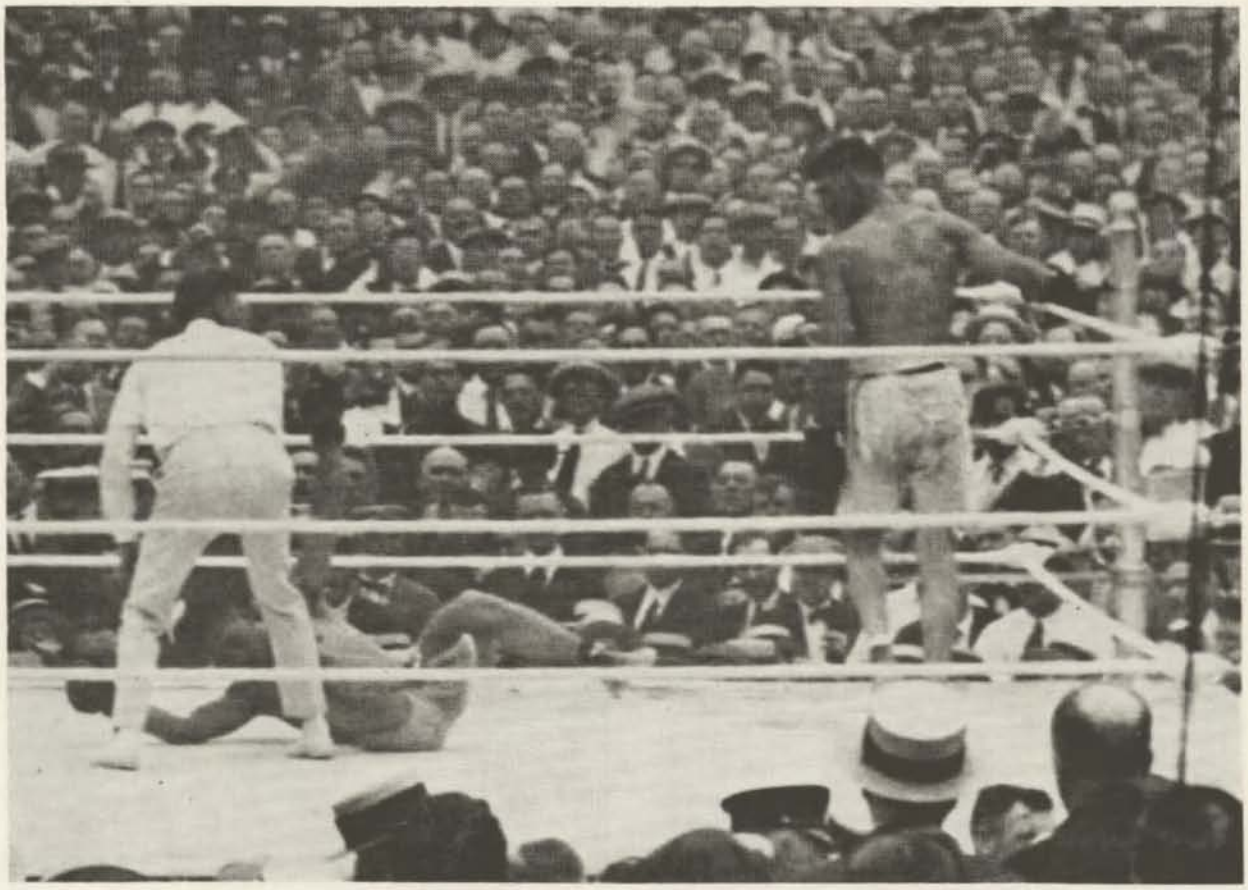


Fig. 5 — The start of the end. Dempsey goes to his corner after dropping Carpentier for the count in the fourth round.

out of the picture. So, the Springfield Amateur Radio Club held a council of war. Soon their strategy took form.

The core of the Springfield Radio Club's activity centered around Court Square in Springfield. Atop the department store next to the Square, the members stretched a long-wire antenna. Inside the store, the club president, H. R. Dyson, installed a special long-wave commercial receiver borrowed from Westinghouse where he worked. Soon loudspeakers bristled from the second and third floor windows like a broadside of cannon out the open ports of Old Ironsides. The battery of speakers consisted of one Magnavox and a number of Victrola horns strapped to the ear-pieces from dismantled Baldwin headsets. Separate audio amplifiers fed the speakers. In addition, two telephone lines from the receiver installation direct to two ot Springfield's newspapers supplied those papers with the fight details a half hour ahead ol the regular news services.

With the preliminary bouts scheduled for 1 PM and the main event at 3, the crowd, alerted by the newspapers, began forming about noontime. By 3 PM the crowd overflowed the Square and completely blocked Main Street running along side. At the arena in Boyle's Thirty Acres, 91,000 fight fans filled the bowl from rim to rim and paid $5.50 to $50.00 per seat to see the fight. At the Plaza Theatre in Springfield, 410 people paid an admission price to sit and hear it. But at Court Square, 10,000 stood elbow to elbow and heard it for nothing—the Springfield Amateur Radio Club forgot to pass the hat around for a donation.

The clang of the bell for round one silenced the crowd. As the announcer's voice poured from the loudspeakers, dignified gentlemen cupped hands to their ears, and little boys sat motionless absorbing every word. Tired business men rubbed elbows with the unemployed oblivious to everything except the battle. From the very start, the lightning-fast Frenchman revealed the potency of his right. Darting in and out, the popular contender caught Dempsey several times with the punch. Rooters in the Square divided pretty evenly between the two contestants. During the action, both sides remained quiet. But between rounds, they cheered wildly for their favorite.

In the second round, Carpentier tipping the scales at 172, exhibited the speed and punch of his light-heavyweight days. Six times he smashed through Dempsey's defense, landing his baffling, brilliant, battering right-cross to the American champion's unshaven chin. The

blows hurt Dempsey. He sagged back and his left leg stiffened when the second blow landed. The furious pelting left him dazed. Carpentier followers, feeling victory, yelled their approval.

But the action of the second round portrayed the final result. Dempsey, unshaven for five days, still stood on his feet. Though Carpentier hit hard, he didn't hit hard enough. Dempsey now knew he could take everything the French contender could offer; Carpentier knew the American champion was too tough for his punches; and the crowd sensed that the smiling Carpentier gave his all in that round and that his all just wasn't enough.

Early in the third round, Dempsey got in his deadly work. The Manassas Mauler, brown from hours spent in the sun, punished the Frenchman with at least a dozen savage blows to the body and chin. Avoiding all long-range boxing, the 188-pound Dempsey kept in close and clinched and battered his smaller rival all over the ring. Dempsey rooters, frenzied by the change in action, roared delight.

Carpentier came to the center of the ring in the fourth, but only his smile and dauntless courage remained. In the middle of the round, a left to the jaw and a right to the body dropped the challenger for the count of nine. But the game Frenchman arose and faced his fate standing up. A woman in Springfield trying to shop said, "Oh that d— fight. We can't get by." Then curiously triumphant she exclaimed, "Dempsey wins by a knockout that's what's the matter." Carpentier lay on his side on the canvas close to his own corner. A left to the body followed by a right to the jaw ended the fight after 10 minutes and 16 seconds of actual fighting.

Things like this make you proud to be an amateur. Hams seldom get an opportunity to make radio history; but when they do, the world can depend upon them to do their part. The Dempsey-Carpentier fight broadcast set a new communication record for voice. Also, it awoke the public to the possibilities of radio and readied them for the era of commercial broadcasting that opened up that fall.

Hams lucky enough to take part in the public presentation of this epic broadcast received a certificate in grateful appreciation. When you're around some of the old-timers, ask them to show it to you. Besides containing the signatures of Franklin Delano Roosevelt and Jack Dempsey, it also contains those of J. Andrew White, Anne Morgan, Tex Rickard, Georges Carpentier, Frank E. Coultry (assistant to Tex Rickard), and Julius Hopp (manager at Madison Square Garden at the time).

(W2NSD from page 4)

understand what is going on. Radio clubs can help quite a bit by encouraging tech sessions during or before meetings to iron out confusion in recent tech articles.

The articles in 73 are particularly well suited for this project because they are all written for the average ham and not for the engineer. You can hardly find an article in 73 that you can't understand if you take the time and effort to actually sit down and read it through.

If every one of our readers followed this idea we would soon find the level of technical understanding moving definitely ahead in our hobby. How about it? Will you give it a try?

In Defense of the Appliance Operator

While it is perhaps rather unlikely that many Appliance Operators will read this, their interests naturally leaning away from a magazine primarily devoted to technical and construction articles, I do feel moved to spring up with a few words in their defense. For those of you who came in in the middle of the show, an Appliance Operator is one who memorizes the theory for the amateur license test, then goes out and buys a complete ham station, which he operates from then until a fuse blows, at which time he rushes back to the dealer in a panic for repairs.

Before I plunge into the seemingly impossible job of trying to cook up a defense for this type amateur, perhaps you might indulge me a moment while I ruminate over how this sort of thing came about.

It is the path of least resistance. The AO is able to get in on most of the fun of ham radio without having to go through all of the horseradish of learning theory. This is made extremely simple by the ARRL and their License Manual, probably one of the most memorized books out today. The great emphasis on operating in QST doesn't help much either. I'm not carping to be nasty, you just pull out the last ten issues of QST and look them over objectively and see what you come up with. How many simple construction projects are there? How many simple theory articles? And more to the point, how many tech articles were there that you skipped over as being too technical? How much space was devoted to operating news? To contests? To awards? What would ham radio be like without the DXCC award, the RCC, the DX Honor Roll, the BPL, and on and on and on? Is it any wonder that we have so many Appliance Ops? It is a

wonder we don't have more! Obviously the ARRL is responsible, in the large part, for ham radio being the way it is today.

But is this all bad? If I am to believe the editorials in QST of late, this is bad. Bill Orr says it is bad. But is it? Let's go back to fundamentals for a moment. Let's go all the way back to Part 12 of the FCC Rules and Regulations. The opening paragraph of Part 12, paragraph 12.0 Basis and Purpose, states that "The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles: (a) Recognition and enhancement of the value of the amateur service to the public as a voluntary non-commercial communication service, particularly with respect to providing emergency communications."

Got that mulled over yet? Mull.

OK, what did they put down as the number one reason for the existence of the amateur service? "A voluntary non-commercial communication service." The Appliance Ops certainly qualify 100% on this, don't they? They are on the air and communicating. How about that . . . " particularly with respect to providing emergency communications" bit? The Appliance Op qualifies 150% here, like it or not. I've overstepped myself now, you say.

(Turn to page 103)

Shocking . . . but true

Jerry Vogt WA2GCF
160 Grafton Street
Rochester 21, New York

A worker got tangled in a 4800 volt primary line; both hands were burned off. A two year old bit into a worn lamp cord; it took several operations to restore his appearance to normal. A ham reached after a part that fell inside his new home brew rig; he lost a finger and almost the rest of his hand. These are just a few examples of many cases of electrical shock which occur every year when we fail to treat electricity with respect.

Fellow hams, it isn't too often that a ham who writes a few articles in his spare time finds a topic which is of interest to every single person reading a magazine. Being of the human race, we all make mistakes. We can all learn from others on this subject. It is much easier than finding out first hand. (Ouch!)

I have recently joined the ranks at R. F. Communications, Inc., a local company involved in the design and manufacture of commercial and military single-sideband and associated types of equipment. Included in a present list of projects is a two-and-a-half million watt pulse transmitter which is the size of about five average ham shacks put together.

Naturally aroused by this project, one of the fellows dug up quite a bit of material on the subject of electrical shock and wrote it up in a booklet entitled "This Will Kill You!" With his permission, I have taken some of these facts and condensed the information into an article which may *Save Your Life.*

Let's start with a few fundamentals. The effect of electricity on the body is determined to a large extent by the amount of current passing through it. There are several different general effects of electricity on the body. When currents in excess of two amperes pass through the body or any part of it, severe burns are usually the result. Currents in this range might be called "frying currents." Some burns are external—caused by arcing at the point of contact. Although they resemble other heat burns, they are usually much deeper. Between the points of contact there are internal burns which cook the flesh, and, if the victim survives, they are very slow in healing. Quite often amputation might be necessary in these cases.

Vital organs and nerves in the path of the current will most likely be destroyed or severely injured. If the shock is caused by alternating current, severe tightening or contraction of the muscles will result. Currents between one and two amperes are called nerve block currents. Because of the damage to nerve centers, a permanent paralysis of various parts of the nervous system might result and chances are almost certain that a temporary paralysis will occur.

Death might be caused by current flowing through parts of the nervous system controlling vital functions such as breathing or heart cycling. Fortunately a chance exists for the victim to recover breathing before the body cells are destroyed for lack of oxygen. Artificial respiration can keep cells alive by supplying oxygen until natural breathing is restored. However, this will work only if the heart action is still strong enough to distribute oxygen in the blood system.

Under normal conditions the heart functions as a smooth-operating type of pump and can be roughly compared with an engine with perfect timing. When a current of roughly 100 milliamperes flows through the body in a path which includes the heart, it may produce a condition known as ventricular fibrillation, a flutter of heart muscles which resembles faulty timing of the valves of an automobile engine. In general, deaths resulting from contact with less than 600 volts is caused by this malfunction. Unfortunately, artificial respiration has little, if any, merit in such a case.

So far we have seen how currents can kill. Don't think, however, that smaller currents are safe. On the contrary, they can be even more dangerous due to other reactions they produce. Currents ranging from 25 to 75 mils may cause unconsciousness and are called "knock-out currents." These won't generally cause serious damage to vital organs but may burn. Because of the severe shock to the nervous system, the current does not need to pass through the vital organs or a major nerve cen-

ter to cause unconsciousness. Injuries will probably not be limited to shock alone but may include burns and sore muscles.

Currents in the vicinity of 25 mils are called "freezing currents" because they cause muscular contractions which freeze the victim to the circuit. Under 25 mils the violent involuntary reaction to shock might injure a person.

So far we have talked about the reactions the body makes and the damage resulting to the body due to varying amounts of current flow. Now let's take a look at how we might come into dangerous contact with electricity and what determines the amount of current flow in the body.

Normally house circuits have both 110 volts and 220 volts available but only 110 volts is accessible. This service in each branch in the house is usually fused for 15 amps. This amount is available in any light fixture or receptacle, but remember we are dealing with only a fraction of that amount. 100 mils is quite capable of killing and 110 volts can easily cause this amount of current to flow in a body.

Your body acts as any other conductor when it is in series with a circuit. A conductor has a certain amount of resistance through which the current must pass. This resistance may be of two types. One, external, is that resistance of a path through the skin. The other, internal, in the resistance through the tissues under the skin.

Skin resistance varies with the part of the body involved, the moisture content and the extent to which the skin is calloused. The most external resistance you can expect to have is 1000 ohms, most likely less than that. A good general figure for internal resistance would be about 300 ohms, again depending on the particular path taken by the current. Considering, then, that the series circuit formed by the body includes the internal resistance and the skin resistance on both ends of that path, we might say that a good estimate of the total resistance the body could possibly offer would be about 2300 ohms.

If you have one hand on a grounded object when operating a portable power tool such as a drill whose frame is crossed with the wiring, the body would offer about 2300 ohms as we have said. At the moment contact is made on a 110 volt circuit at 60 cycles, the body will pass 50 mils. You would either freeze or be knocked out. After only three seconds contact, blisters would start forming and the body resistance drops to 500 ohms. The current through your chest would be now raised to 220 mils, more than enough to start the deadly

fibrillation effect on the heart. This could be fatal.

Wet shoes present an even greater hazard due to increased contact area and moisture content if the path happens to be from hands to feet.

When the current approaches one ampere the contractions of the muscles in the body may become so severe as to tighten every muscle in the body and may throw the victim from his deadly position in contact with the wires. However, it is likely that the damage to the heart controlling nerves would have already been done and death would still result despite the fact that the circuit had been broken.

The severity of the damage always increases with the length of time the body is in contact with the circuit. This is due to the blistering and burning effects at the points of contact as well as injury to the vital organs and nerve centers in the pathway. The higher the voltage, the quicker this takes place. Blisters form in seven seconds at 50 volts and in three seconds at 110 volts.

To review: the factors involved in the danger of electricity to the body are: The amount of current, the pathway this current follows and the length of time of the contact. The important thing to remember is safety. Be sure there is no potential shock *before* you go toward a circuit to work on it. Be sure the house circuits are safe. Go check them now. Electricity can be a useful servant—it can also be a deadly enemy.

. . . WA2GCF

Slow Scan Vocoder Transmission

Dana Griffin W2AOE

Everyone with a reputation in the scientific community, however small it may be, is delighted to see his work used by others as the foundation for a further advance in the state of the art. This is the sort of thing which leads to progress in every field of scientific endeavor from better mousetraps to better H-bombs.

The writer was quite astonished to see that his work on bandwidth conservation, which was published in the February and March issues of QST, had been used by Dr. Costa and Mr. Rapp as the basis for an even greater advance in the quest for bandwidth conservation as described in the columns of the July issue of 73 Magazine.

The use of the Bell Laboratories Vocoder Transmission System, which Rapp cleverly purloined from the archives of the mostest of the mostest in Murray Hill, N. J., has undoubtedly begun to generate a great deal of interest on the part of amateur sideband operators, who pursue a further reduction in the bandwidth required for voice transmission with the ardor of a Richard Burton.

Perhaps it was the lateness of the hour or merely the magnitude of Rapp's corporate planning for the mass production of gear for military and amateur Vocoder System Transmission (VST). But to have both of these erudite gentlemen miss the opportunity to present what appears to be the ultimate system for bandwidth conservation, simply astounded me.

The key may be found in the third from the last paragraph of Dr. Costa's story. I quote, "Could it be that the information rate is the fundamental quality and not the bandwidth?" Why didn't you answer your own question, gentlemen? This is *it!*

If you had done so, I would have been denied the honor and prestige of presenting to a waiting world, "The Slow Scan Vocoder Transmission System," or SSVTS for short. It is unfortunate that this system will destroy Rapp's dreams of empire before they get further than the initial planning stage. But the SSVTS concept will only require a bandwidth of 30 cycles in place of the picayune reduction from 3000 cycles to 300 cycles as proposed by Rapp.

We must admit that the "ex" sidebanders using this new system must start with the VST system proposed by Rapp. But this system cannot be put on the air because of the excessive bandwidth of 300 cycles for voice transmission which it requires.

One must slow down the rate of information transmission to conform to the new 30 cycle limit for narrow band tone transmission, which the FCC will undoubtedly require when the SSVTS system emerges from the prototype model stage. This is the key point which Messrs. Costa and Rapp missed.

Unfortunately, the means to accomplish this are not patentable. They are well known even to the lowly hi-fi fan. Instead of modulating

the transmitter directly, the voice actuated Vocoder output is recorded on tape at the rate of 17.75 inches per second. By means of another head and motor drive, the Vocoder will modulate the transmitter at the tape speed of 1.775 inches per second. At the receiver, the process is reversed. After the incoming signal has been recorded at 1.775 ips, it will be fed into the receiving Vocoder at the rate of 17.75 ips. Presto, out comes the voice at the other end of the radio link.

The 100 to 1 reduction in voice transmission bandwidth which the Griffin SSVTS system provides, makes Rapp's 10 to 1 reduction in bandwidth appear ridiculous by comparison. Inasmuch as an SSVTS QSO will take ten times as long to complete as it does today, brevity will become the watchword of every SSVTS operator.

Dr. Shannon's work on the redundancy in speech clearly indicates that SSVTS operators will undoubtedly become masters of monosyllabic conversation. Conversely, the verbose types, so prevalent on AM, will never know the joys of SSVTS communication. One of their typical short QSO's would last longer than a chess game via mail between Keokuk, Iowa and Kazahkstan, Siberia.

BUYERS GUIDE CORRECTIONS

Considering the number of possibilities for errors we didn't do too badly. Hallicrafters reported a rash of orders for their $2650 FPM-200 which we put in for $26.50. I believe the price on the 200 is back down to $1995 now, in case the high price was holding you back.

World Radio got a shock when we rated their Galaxy 300 at only 200 watts PEP. Since they went to an awful lot of trouble to have the rig develop 300 watts I can see their point. The Galaxy 300, for clarification, is a $300 sideband transceiver for 80-40-20 meters which runs 300 watts PEP or SSB. The ac power supply with clock is $119.95, less clock $99.95, and the accessory VOX $24.95.

Hunter pointed out that their Bandit 2000A linear only required 100 watts of drive, not 160 as reported.

Redline noted that we mixed up the type on their ad. Nothing personal.

When SSVTS communication is employed by thousands of displaced SSB operators, another not so obvious revolution in communication practice will be in order. Inasmuch as SSVTS voice communication only requires a 30 cycle bandwidth, for the first time in history the SSVTS fone men can gripe at the excessive bandwidth used by CW men when they send at 40 words a minute or more.

Fortunately, there are two solutions to this problem. The high speed CW men and the RTTY gang can also use SSVTS techniques. The second, less expensive solution which the high speed CW gang can employ, is to shift to single side band CW transmission. thereby cutting the required bandwidth to 50% of that which they need today.

It will take considerable time for an appreciable number of SSB, RTTY and CW operators to convert to the new SSVTS mode of communication. It is difficult to visualize all of the effects that the adoption of this revolutionary technique will create.

Is this the ultimate scheme for bandwidth reduction? We are inclined to think so unless Messrs. Costa and Rapp can come up with a method to modulate an AØ carrier, using mental telepathy.

All facetiousness aside, as a group, the amateur body will undoubtedly be forced to come to grips with many new problems when thousands of displaced sidebanders shift to the SSVTS mode.

For example, our population increase cannot possibly keep up with the amount of empty space in our bands which will become available when the use of SSVTS becomes widespread. Unless these vacant holes in our amateur bands are completely filled up with spectrum wasting AM QRM, these channels may be taken over by the commercial interests.

But wait, fellow amateurs, I don't intend to permit Messrs. Costa and Rapp to "tat" me again after producing such a magnificent "tit" as the Slow Scan Vocoder System Transmission concept. I also lay claim to the use of restricted licensed technicians using wideband pulse position modulation on 20, 40 and 75 meter fone to fill up the holes which SSVTS will create. Lastly, in a justifiable attempt to out Costa Dr. Costa, if two sidebands are better than one, why not 4, 6 or 8 sidebands? All you need to do is to put AM subcarriers on an AM suppressed carrier system at 10 kc intervals from 3800 to 4000 kc. I am now one tat and one tit ahead; gentlemen, it is your turn to tat.

. . . W2AOE

(W2NSD from page 97)

What sort of equipment do you want in emergencies? Do you want home made gear that only the builder knows how to hook up or tune? Gear that might go pffft at the wrong time and need its daddy to get it back on the air again? Or do you want commercial gear that everyone knows how to use . . . stuff that is designed to withstand the mishandling of idiots and still put out good signals Our Appliance Operator wins hands down here.

Part (b) has to do with the amateur contributing to the advancement of the art. Our AO contributes here too, but only indirectly. The size of the ham market today makes it possible for amateurs to design products for sale to amateurs and this has greatly stimulated amateur advancement of the art. Immediately comes to mind such achievements as the 600L, the 100V, and the many sideband transceivers we have today.

Part (d) "Expansion of the existing reservoir within the amateur service of trained operators, technicians and electronic experts." Here we see that the FCC has established our AO as one of the three types of amateurs that are considered important. And they are important. In time of emergency we need fellows who know how to use radio equipment and know how to communicate. You often don't have the time to teach a non-ham how to go about communicating. Even in war time our AO is way ahead of non-ham. I recall the early days of WWII when the great percentage of the licensed amateurs went into the armed services. They didn't know any more than hams today, but they were able to learn quickly enough in the armed forces schools. They had a considerable advantage over other fellows in that they liked radio, even if they didn't know much about it. . . . I remember, I was one of them.

Do you still sneer at the Appliance Operator as a nogoodnick? It's true, our AO could be worth a lot more to the amateur service if he were not only a trained operator, but also a technician or electronics expect. He would probably get even more enjoyment out of amateur radio too. Contests are fun and they develop one's operating ability to a high state of perfection, but I feel sorry for the ham who has not lived through the experience of building a piece of equipment and getting it going.

I'm not out of ammunition yet. Part (e) says, "Continuation and extension of the amateur's unique ability to enhance international

(Turn to page 104)

(W2NSD from page 103)

good will." Ha! Sure, our electronic experts can bring us good will if they will get on the air and talk to some DX stations. So can the technicians. But our Appliance Operators are on there day in and day out working every DX station they can pull through and doing a rather thorough job of international good will. Some of 'em are lousing things up, too.

In reviewing the Basis and Purpose, as set forth by the FCC, it seems to me that our rules are quite explicit in their establishment of the worth of the so-called Appliance Operator.

DXpeditions

The main complaint I have with DXpeditions is that I'm not on 'em. Back in 1957 six of us went down to Navassa Island, struggled some thousands of pounds of equipment up the lousy cliffs, operated around the clock for four days and probably enjoyed it more than anything else any of us have ever done.

Gus makes me sick. Gus is ruining all of the choice DX spots. He is going everywhere and working thousands of stations. He is even up in Nepal! It is awful. New Hampshire is very nice, but I sure wish I could be DXing from some spot like Nepal. Now there is no point in it. I figured that in another year or two 73 might be doing well enough to start putting on little DXpeditions. By the time we have a few hundred dollars saved up there won't be anything larger than a rock sticking out of the ocean in Antarctica that hasn't been worked by everyone.

The Hammarlund DXpedition of the Month program is eating away at the rare spots something fierce. The DX fraternity is fortunate to have a DX nut running Hammarlund. That's a pretty clever way of getting some new ones, eh? Stu Meyer W2GHK is to be congratulated for resisting the temptation to over-commercialize on these DXpeditions. .

Say, if any of you hook up with any of the many DXpeditions, why not put the pressure on them to write about some of their mishaps and adventures and send them in to 73 so we can all enjoy them. No matter how you feel about Danny, you'll have to admit that his stories that I published in CQ a few years back were darned exciting. Wayne

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(Match from page 25)

Gym classes are a good idea—especially exercises on the parallel bars and trapeze lines. Not many hams can afford automatic push button collapsible towers for their antennas. But a surprising number can afford Xyls—the tree climbing kind, who can go up a ladder or tower at a moment's notice, without any qualms over dizziness and the height factor.

Lucky for you if you have been through the ropes in your Brownie and Girl Scout stages. Better just brush up on all those knots you have learned and never found any use for, as yet. You will be using them quite unexpectedly every time antenna changes are made. Sparks (of temper) will fly if your clove hitch tangles into a granny, and down comes what was designed to be the best antenna yet!

"Be Prepared" was once your motto—well carry it across the border into your next state (married, that is). Always "be prepared" for your OM disrupting the ordinary household. Funny(?) how he will decide that hole has to be drilled through the plaster, or a major rebuilding job has to be done right on the living room rug, just after you have finished the weekly vacuuming. Walls, floors, and ceilings present a challenge to the ham experimenter, and eventually might resemble a woodpecker's habitat. Any building, or your favorite tree may have to come down if it stands in the way of progress in radio propogation.

Diplomacy should be practised until it becomes second nature to you. When the local tv repairman fiendishly points out your OM's antenna farm to your neighbour, as the logical cause of all your neighbour's tv troubles; and the hitherto friendly couple living next door, suddenly descend upon you, transfixed from their Dr. Jekyll to Mr. Hyde state—remember, taking your shoe off and banging it on the desk, will get you nowhere. Invite your irate visitors in, extoll the fascination of hamming, let them twirl the magic knobs, and bring in the exotic dx. If you can only convert them to the hobby, your OM might get permission to extend his antennas into the next yard, and try for that 40 meter beam he has been dreaming about.

And contests! All ham activity tends to peak up in the weeks preceding the OM's favorite contests. And there is a contest just about every weekend. By zero hour when the contest starts, he will be absolutely confident that he is going to win. Since there are probably 10,000 or more amateurs in this contest, and only 1 winner, be prepared to face his frustrations a little later. It's an unbroken rule, that 1 hour after a contest has started, Murphy's Law, and IPIO will have taken command of the ham shack. If you have not run into

these two yet, let me fill you in. Murphy's Law states that if anything can go wrong, it will; and IPIO is the Innate Perversity of Inanimate Objects. So, watch out!

Possibly the zenith of all ham activity reaches its climax in that most glorious weekend in June. No, not the Niagara Falls type weekend to get away from it all—but the hams dream come true—field day— 48 hours solid of hamming, hamming, hamming! Just working one station after the other, the more the better. No distractions, no meals, no sleep, no shaves—not one thing can interrupt this strange annual phenomenon. Better plan on going home to Mother on field day weekends.

What's that you say? You are not going to leave Mother? You are going to put off the wedding date until you study up on the code and theory, and get yourself an Amateur Licence! You've read about G3NMR's friends, Em and Joe. You did not like Em, and you are not going to be like her. You want Bob and you have a perfect match. (Both ways!)

Well, good for you. Vy Fb!

Oh, but better not tell Bob I've had this little chat with you. If he asks for me, just say I rather unexpectedly left on a DXpedition for parts unknown.

. . . VE3DGV

73 parts kits

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER PREAMPLIFIER. Uses two 6CW4 nuvistors in a grounded grid input circuit (March '63 p8) and one 6CW4 nuvistor grounded grid output. Complete with power supply. Uses 50 volts on the plates for extraordinary noise figure. Full scale drilling template supplied.
W9DUT-1 .... $18.50

QRP TRANSMITTER. Have fun with this little one half watt CW rig on 40 meters. Uses any 40M surplus crystal. Kit supplies 1S4 tube and socket, condensers, resistors, coil, rf choke, terminal trip, etc. Runs from flashlight battery for filament and portable radio 67½ volt B-battery. See March '63 p22
W1MEL $6.00

15-20 METER NUVISTOR PREAMPLIFIER. Need more hop on these bands? This simple to build preamp will bring up those signals. This is particularly good for inexpensive and surplus receivers. See April '63 page 40
W6SFM-1 .... $4.00

TRANSISTOR POWER SUPPLY. Voltage regulater adjustable power supply for running transistor equipment. Takes the strain off those transistor batteries. Great for the test bench. See April '63 page 8. Uses five ransistors, one zener, cute little (expensive) meter, etc. Will deliver up to 100 ma continuously, voltage from 0.35 to 15.0.
W1ISI $25.00

TRANSISTOR TRANSCEIVER. One of the most popular kits we've ever assembled is this six meter miniscule transistorized transceiver. Really works. Hundreds built. See page 8 in the May '63 issue. Five transistors.
K3NHI $25.00

CW MONITOR. Connects right across your key and gives you a tone for monitoring your bug. Page 44, June '63.
WA2WFW $4.25

TWOER MODIFICATION. Increase your selectivity considerably by installing a new triode 7587 nuvistor stage. This is our best selling kit to date. Everything you need for the modification is included. See June '63 page 56
K6JCN $6.50

SIX METER CONVERTER, DELUXE. 6EW6 low noise front end, 6U8 oscillator and mixer. Output is 10.7 mc (easy to change to suit your needs). This is a tunable converter with fixed frequency output, not the usual converter that requires you to tune the receiver. This helps considerably on eliminating interference from nearby high power stations. See page 8, July '63.
W9DUT-2 .... **$20.00**

TUNING EYE KIT. This kit enables you to install a dual tuning eye in any transmitter to indicate the tuning of two or more stages. It works far better than a meter or even meter switching. See page 22, July '63.
K6GKU $7.50

NOISE CENERATOR. Invaluable test instrument for tuning up rf stages, converters, etc., voltage regulated by a ener diode. Kit includes even the battery and mini-box.
K9ONT $5.00

CAST IRON BALUN. Eentsy balun using ferite core, covers 6-40 meters, will handle up to 20 watts, complete with cabinet, connectors, etc. See September 1963 page 8.
W4WKM-1 .... $3.00

BOURBON S-METER. Much better than the usual Scotch S-meter. Here is an S-meter kit for those of you with receivers without S-meters. Includes tube, adjusting pot., socket, resistors, and meter. See September 1963 page 18.
W6TKA-2 .... $6.50

NEW PARTS KITS

Bowing to reader demands for us to enkitify some of our past construction articles, we hereby present three new parts kits.

TONE MODULATED CRYSTAL STANDARD. Uses one tube and one mc crystal to generate 1 mc markers all the way up through 225 mc. The built in tone generator makes it possible to easily identify the markers. Including Minibox, tube, crystal, etc.
W9DUT-3 .... $15.00

TRANSISTORIZED MODULATOR. 40 watt modulator, excellent for plate modulating mobile rigs, four transistors, uses 12 volts dc, only draws 250 ma while resting with peaks of 4-5 amperes. Kit includes transistors, transformers, resistors, condensers, etc.
VE7QL $27.50

SHORT WAVE CONVERTER FOR HAMBAND RECEIVERS. One tube short wave converter so you can tune SW broadcast stations. Power supply included.
W2LLZ $13.00

WRETCHED K2PMM

BADGES $1.00 each.

One of the big problems at hamfests and club meetings is to have everyone plainly enough marked with their first name and call. All sorts of stickers and pieces of cardboard have been tried, plus little cards which can be typed up and stuck in holders . . . all have the same problem: they are hard to read from any distance.

The best answers to date are these engraved laminated plastic name badges which can be read by Cousin Weakeyes from seventeen paces. You are in luck. We've arranged to make these darbs available at a real low price, all personally engraved. The badges are 3" x ¾" and come complete with a pin and safety lock. Please give your first name, call and specify whether you want the badge to be bright red with white letters or jet black with white letters.

Order from

73 Peterborough, N. H.

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6up. Monthly VHF magazine, editor Jim Kyle K5JKX, technical articles and latest VHF news from all over the country. $2.00 per year.

ATV Bulletin. Semi-monthly bulletin for the ham TV enthusiasts. Technical and operating news. $1.00 per year.

5/7/9. Monthly bulletin for those interested in contests. Lists all contests being held, gives rules and results on contests not covered in QST or CQ. $2.00 per year.

73 News. Published monthly, editor VE3DQX. Keeps you up-to-date on current ham events.

In valuable to club officials for discussions at club meetings. Good source material for club bulletins. 1.00/year.

Ham-RTTY. This is the most complet book on the subject. Written for the beginning TT'er as well as the expert. More complete and authoriative than books at twice the price. Pictures and descriptions of all popular machines, where to get them, how much, etc. $2.00

Bound Volume 1. Gorgeously bound library volume (bright red) of the first fifteen issues of 73. This is the only way to get a complete set of the early issues of 73. We'll pay $1 each for copies of the January 1961 issue in good condition so we can make a few more bound volumes. Covers October 1960 through December 1961. $15.00

Bound Volume 2. Complete matching volume covering 1962 issues of 73. $15.00

Binders. Bright red leather binding. Specify which year you want stamped on them: 60-1, 62, 63. Darbs. $3.00 each.

Back Issues. Since each issue of 73 features articles of a fairly timeless nature each back issue is just as much fun reading as the current issues. All back issues except January 1961 (we'll pay a dollar for these if you can find any) are on hand, some in mighty small quantities. 1960 issues $1.00 each. February 1961-date 50¢ each.

Care and Feeding of Ham Clubs—K9AMD. Carole did a thorough research job on over a hundred ham clubs to find out what aspects went to make them successful and what seemed to lead to their demise. This book tells all and will be invaluable to all club officers or anyone interested in forming a successful ham club. Hundreds of grateful letters have been received from clubs who have applied the ideas in this book. $1.00

Simplified Math for the Hamshack—K8LFI. This is the simplest and easiest to fathem explanation of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc. If our schools ever got wind of this amazing method of understanding basic math our kids would have a lot less trouble. 50¢

Index to Surplus—W4WKM. This is a complete list of every article ever published on the conversion of surplus equipment. Gives a brief rundown on the article and source. $1.50

Ham-TV—WØKYQ. Covers the basics of ham-TV, complete with how to get on the air for under $50. Not the usual theory manual, but a how-to-do-it book. $3.00

Surplus TV Schematics. You can save a lot of building time in TV if you take advantage of the real bargains available in surplus. This book gives the circuit diagrams and info on the popularly available surplus TV gear. $1.00

AN/ARC-2 Conversion. This transceiver sells in the surplus market for from $40 to $50 and is easily converted into a fine little ham transceiver. Covers 29 mc (160-80-75-40 meters). This booklet gives you the complete schematic and detailed conversion instructions. $1.00

AN/VRC-2 Conversion. Completely different from the ARC-2. This book gives you complete instructions on converting the inexpensive VRC surplus gear into a six meter wide band FM transceiver. There are probably over a thousand stations now operating on 52.525 mc around the country. Join the crowd. Fun. $1.00

Coils—K8BYN. Basic book which covers the theory and practical aspects of the many different types of coils found in ham work. Well illustrated. 50¢

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Impedance Bridge. Full scale construction prints for the bridge described in the August 1961 issue of 73. Comes complete with a reprint of the article. Watch out General Radio! $1.00

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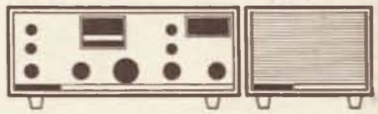

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73 Magazine

Wayne Green W2NSD/1
(no relation to Joe
Green, the composer)
Editor, etcetera

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de W2NSD/1

never say die

It is not good to be back. Our little jaunt across Europe with 73 hams and wives was an extraordinary success from every standpoint and I think that most of us are busy driving all close friends and relatives out of their minds with stories of the fabulous foods we ate, the places we visited, the people we saw, the audience with the Pope, etc. I'll give you more details next month when I have had time to get some of my pictures developed.

As I talked to the leading amateurs in England, France and those gathered at Geneva I became more convinced that my ideas for preparation for the eventual Geneva I.T.U. conference have a greater possibility of keeping ham radio alive and healthy than any other plans put forward. I was particularly disappointed in the reaction of the ARRL to the situation.

To ennutshellify it, the ARRL plan is to woo the amateurs of other countries into being more favorably disposed toward U. S. amateurs by making *our* regulations stiffer. The ARRL'ers were considerably impressed by the severity of the amateur license exams in other countries as compared to the U. S. I found myself resisting the normal impulse to accept the European way of doing things as being better than ours.

Why should we accept their way of doing things? What results do they have to show for their system? Every single country is far behind us in amateur technical development, amateur operation and emergency service. They are behind us because they are hamstrung by restrictive regulations which have prevented the normal growth of amateur radio. If we want to do something to help amateur radio at the next frequency conference wouldn't we be doing a lot more if we were to do everything in our power to encourage amateurs in other countries to get their regulations relaxed enough to encourage a healthy growth? I think we have enough incontrovertible reasons for a strong amateur radio service to eventually sell even the most difficult foreign government officials.

This goes back to my editorial of last month wherein I discussed the basis and purpose of amateur radio. Amateur radio has been established in the U. S. to provide:

a) A non-commercial communication service.
b) Emergency communications.
c) Advancement of the art.
d) A reservoir of trained operators.
e) A reservoir of technicians.
f) A reservoir of electronics experts.
g) International good will.

We should look over this list with the question, "How many amateurs do we need to adequately fulfill the requirements above?" in mind.

Though one cannot assign definite numbers to each category, it is not difficult to set up a general working agreement. If we are to have a useful non-commercial communication service then we must have active amateur stations in every community. I would think that one active amateur station for every thousand people would meet this requirement. This should also hold for emergency communications, where this would seem to be a minimum desired concentration of amateurs.

We have shown here in the U. S. that the advancement of the art provided by amateurs is a function of the number of amateurs. Thus the more the merrier as far as this is concerned.

In time of war one of the country's greatest assets is a reserve of trained radio operators, technicians and experts. Amateur radio certainly did provide them during the last war when, I believe, almost 70% of the amateurs joined the military services. The service schools were staffed almost entirely by amateurs. The armed services could have easily used four times the number of amateurs that were available. Now, some twenty years alter, with electronics of far more importance than it was

(Turn page)

then, the armed forces would need every man that amateur radio could provide.

Thus, if amateur radio is to achieve the goals set for it as a service by the FCC regulations, we find that we should have an active amateur population on the order of 200,000. I suspect that we have about half of this at present, despite the 250,000 licenses out. But, if we are short of our goal with 100,000 active amateurs, or about one amateur per 1800 of the population, how short are the French with about 2000 active amateurs, or one amateur per 25,000 population?

Perhaps instead of expending all of our energy on promoting such schemes as restricted voice bands we would do better to try to *interest foreign governments in encouraging* their amateur service by modeling their rules after ours, which have proven themselves. If France had 50,000 active amateurs the French would find themselves with all of the items on our list, a through g. They would also find that this number of active amateurs would bring about a tremendous increase in electronic manufacturing in France as a result of the demands for amateur equipment and parts.

I don't have to go into details as to the side benefits of having 50,000 radio amateurs. A goodly number of them, through their interest, will go into electronics and this would naturally result in a great increase in French electronics manufacturing of all kinds. In case of emergency the French Government would have 50,000 complete operating radio stations available for government use, plus operators, technicians, etc.

While I have used the French as an example, this same thought applies to virtually every other country in the world, and in particular to the newer countries, the ones that we are so afraid will upset our apple cart at Geneva in a couple years or so. If we went into an international conference with 1,000,000 active amateurs we might be able to regain some of the previously lost amateur frequencies and certainly wouldn't have to worry much about losses.

Now, which seems like a better approach to you? Should we set about making amateur radio more difficult here, restrict frequencies, and decrease our activity? Or would it be better to start working on getting amateur regulations eased in other countries, cutting down on import duties on amateur equipment and doing everything else we can think of to increase the number of radio amateurs throughout the world?

(Turn to page 30)

Some Guys Make it . . .

and then there's us

Jean Shepherd K2ORS

You know, when you really step off a cliff, you know you've done it. It's just like looking out from the observation tower at the Empire State Building, and suddenly you're in mid-air and you know that there's no going back. I mean, it's a great flight, while it lasts.

It's maddening. You notice that up and down the street, the guys in the big Cadillacs never get tickets? Have you ever yet seen a ticket on a fat Mercedes? Let me tell you, I used to come back with my motor scooter decorated like a Christmas tree. You know, all those little green tags hanging like tinsel all over it. And in front of me would be a tagless Cadillac, and behind me a tagless Mercedes. Both parked there since last Easter. My scooter . . . I'd slow down, and the fuzz would be running alongside me, tying 'em on.

Well, that goes in all directions. There are guys who always get it you-know-where, and there are guys who don't. It's just that way. Now I don't know how it's set. I don't know whether it's predestination. I don't know whether it's pre-ordained, but some guys from the very minute they're born—and they can be born in a rotten neighborhood—but from the very minute they're born, they are preordained or something to Make It. And there are other guys who are born to be Sunk. I mean just born to it. Your ship is leaking. From the very minute you start to walk. Your shoes squeak. And you're phonying it up, and hoking it up from the time you're six. Other guys *win* the sack races. You know, legitimately. They can run faster.

Well, let me tell you what happened one time. I'm on the air, you see. I'm a ham, and this is when I began to discover this principle. I'm a kid, and I got this paper route—rout. It was both a route and a rout. It's terrible to have to admit that even when I was a paperboy, I was a paperboy for a paper that was about to go out of business.

Every week you'd come around and you'd try to collect, and they'd tell you they want to drop the subscription, it's a rotten paper. It's awful. I had a paper called the Herald-Examiner. Did you ever hear of it, the Chicago Herald-Examiner? And you know it was such a bad paper that they didn't even read it in my house, and we had a free subscription.

I used to go running around the neighborhood at four o'clock in the morning, delivering this rotten paper. It was a losing battle. And on Saturdays, every morning, I would go up and I'd knock on every third door, trying to collect the dough, and they'd say:

"Here's forty cents for last week. Please don't deliver the paper any more."

Well, then I'd have to go back and tell George The Paper Man that they quit down there, on Cleveland Street, those people down there, and he'd say:

"Ah, they're rotten people."

George was fighting a losing battle too, because he had the Herald-Examiner franchise in the neighborhood and he was going down with the ship. And all these poor little kids who were 12 years old and who were getting knobby knees from running around with this paper, they were going down too. Whereas right across the street from us there were a bunch of wiseguy kids who had the Tribune. And this big fat guy who had the franchise for the Trib. And they all got fat. All those kids are Republicans today. And Cub fans. All of the rest of us kids that had the Herald-Examiner, look at us. Ha! Democrats, follow-

ing the White Sox till the day we die.

So anyway, I'm a kid and I get my ticket, and I figure I'm licensed, like all the rest of the guys. Except, of course, the Cadillac has the same kind of license on it that you've got, you know. It's the same piece of metal on the back, but Boy, what a difference.

So I get my ticket. I'm really gonna swing. I'm on 40 cw for about six or eight months, when I get on 'phone. Now I'll tell you what I was doing as far as 'phone is concerned. I figure I'm gonna try and make it in the big leagues. And I have a single 2A5. Final driven by a 56 tri-tet osc. Do you know anything about the 2A5? Well, it was a Pentode, a Power Pentode. Receiving type. I got ahold of this 2A5, and I was using a Majestic B Eliminator, which I had found in the basement of somebody's house, to power this thing. And it put out 135 volts. I can tell you exactly what was running, it was 135 volts on the plate at 10 mils. So you can figure out what my input was. Into an RCA mismatched receiving doublet SWL antenna. A special design they had to mismatch on everything. Didn't match anything. I could have done better with the bedsprings.

And so I've got this thing tuned up, and I'm running a cool 135 volts at 10 mils on the plate. I built a modulator. Oh, when I think of it . . . how sad.

The modulator was another 2A5, and I am grid-modulating the final. Well, you can realize the kind of output I have. I'm probably running about 7/10ths of a watt, and you will never guess what band I'm running it on. I'm on 160 meters. Where a low power guy was running 200 watts and the high power guys ran all the way up to, well, I would say WNBC standards.

I had this poor little receiver. I don't know whether you ever heard 160 meters when it really was wild. You know what you could do on 160? You could tune into the band, and when you hit the band it was one hetrodyne from one end to the other. One *solid* hetrodyne, without a break. And the hetrodyne was of such a magnitude that your S-meter was on the pin all the way across the band. It never fell off.

So one night I'm on there. I throw my 7/10ths of a watt right into the middle of it all. I have a very vocal special sound, the bored sound of a high power man, calling CQ. Nonchalantly:

"Hello CQ, CQ. 160. Hello CQ, hello C2, Hello CQ". Then there's a little silence while I'm tuning. Sound of arc being drawn by pencil from final plate.

"Hello. One Two Three . . . hello. Hello CQ, hello CQ, hello CQ."

Where you really sound like a big leaguer is when you turn the radio in the next room all the way up, so you sound like you've got so much power and so much gain, so much preamp gain that you can't cut down the background noise in your house. It sounds real great.

I've got the cans on. I'm wearing cans monitoring myself on my receiver. I am the only guy who can hear me, the only guy who could hear my signal.

"Hello CQ, hello CQ, hello CQ, hello CQ."

It's 9 o'clock at night, and everybody in the country is on. Believe me, that band was so insane and my rig so weak that with my signal on and my receiver on, I could hear the hetrodynes through my carrier. If you know what I mean.

"Hello CQ, hello CQ, hello CQ, hello CQ 160, hello CQ."

I am calling CQ from 9 o'clock at night till 4 o'clock the next morning. All I am raising is our light bill. That's all that's happening. So the next night I come on again. I get on the air again, and it's great, you know, just to throw on all the switches. The one thing I had that was heartwarming was that my BH tube was leaky. I had a gassy BH. Did you ever hear of the BH cold-cathode rectifier? Well, it was leaky. It was gassy, it made a beautiful blue light like an 866 when I talked. Made me feel like I had real power.

"Hello CQ, hello CQ, hello CQ, hello CQ, hello CQ." And I'd see that blue light flickering. It was just great.

"Hello CQ, hello CQ, hello CQ, hello CQ."

Well, this goes on for one solid week. They can't even hear me in the next room. I haven't raised even a BCL.

"Hello CQ, hello CQ, hello CQ."

Finally Friday night comes along. Friday night comes along. And my friend Chuck, down the street is W9AHS. He is running 6/10ths of a watt on 20. He has not worked anybody on 20 since the preceding Spring, when he worked a guy who was mobile and who drove right past his house. So the two of us are in the same leaky rowboat.

Chuck comes home from school, and he says:

"You're on 160, huh? How're you doing?"

And I say:

"Ah, pretty good, Chuck. How are you doing on 20?"

Twenty is a real Big League band. He says:

"Oh, not bad. Not bad."

We both made Class A, you see, but I didn't

have the guts to go on 20 yet, because the band scared me.

Chuck says:

"What do you say we work a little Cross-band tonight?"

Chuck lived 10 blocks away from me. So I say:

"Okay, Chuck."

So Chuck has got his receiver tuned to 160 and I'm listening on 20 and sure enough, between all the hetrodynes I hear Chuck come in:

"Hello, hello W9QWN, hello W9QWN, W9QWN. W9AHS calling W9QWN."

So I throw on my transmitter. I'm on 160:

"Hello W9AHS, W9AHS."

And Chuck comes back to me! Fantastic! He could hear me. Right in between all the hetrodynes he says he could hear this little squeak, this little thing. He says:

"You're coming in. You're about an S-2. About an S-2. Readability is very low. About an R-3, I'd say, about every 3rd or 4th syllable."

So, without thinking about it, we slip into Cross-band work, into duplex. And I leave my transmitter on, Chuck leaves his on, and I'm talking to Chuck. We worked Cross-band, *duplex*, for not more than 30 seconds.

Illegal.

And I'm talking to Chuck, Chuck's talking to me, back and forth. It was great. Finally:

"73, Chuck."

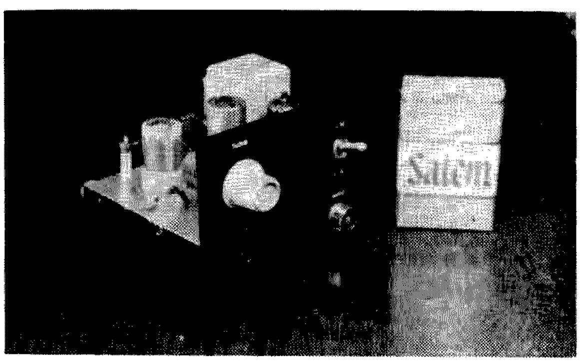
"Okay. Dad."

"Hello CQ, hello CQ, hello CQ, 160 phone —hello CQ, hello CQ."

Six or eight weeks go by. When suddenly, in the mail, would you believe it? I get a card from the FCC. They got a listening station in San Diego. And they have ticketed me for Cross-band illegal operation. I am coming in there 599 XXXX. A ton of bricks! On 160!

Well. I figured, you know, there's some guys get ticketed and then there's others that don't. About that time I realized that there are born losers and there are born winners.

Oh well, it doesn't matter. It only gets worse. But the thing you got to keep saying to yourself is that it gets worse for everybody, simultaneously, all of the time. Maybe.



The QRP Kilowatt

William Starr WA4DQS
1851 West Oakland Ave.
Sumter, S. C.

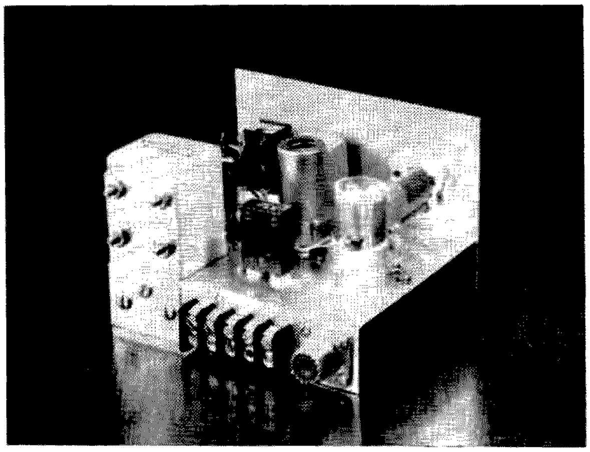
Parts Kit . available

One day about a month ago, KØDRI/4 and I were having one of our crosstown QSO's and he mentioned the article in 73 describing a QRP rig for 40 meters.* The outcome of the ensuing conversation is described here. KØDRI stayed in the spirit of things and built a real QRP transmitter, 675 milliwatts to a 1T4. I, however, got caught up in the mad rush for power and went the whole way—2.5 watts CW! Then of course came the logical next step, AM. I realize that all true blue QRP fans will rain curses on my head for introducing this overpowered station, but such is the price of progress.

Circuit

The circuit is quite straight-forward. A 6AH6 acts as a crystal oscillator-amplifier. The screen is fed with 150 volts regulated and acts as the plate of the oscillator circuit. It would be possible to use unregulated voltage here but I would be alert for chirps on CW and FM'ing on AM. Capacitor C-2 is an excitation control and more will be said on it later.

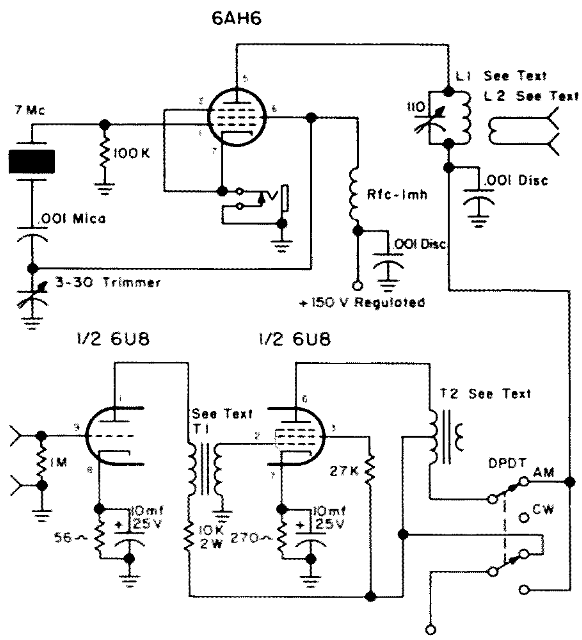
* QRP Transmitter, 73 Magazine, March 1963.



The speech amplifier and modulator section uses a 6U8 triode-pentode. Many experiments were made before settling on this tube and circuit. The final decision was probably due more to the contents of my junkbox than anything else. For those with an experimental nature and a better junkbox I recommend trying a EZ8 triple triode, running one triode as a voltage amplifier and the other two in push pull as shown in the alternate modulator circuit. A small rectifier working from the 6.3 volt AC filament supply provides -4 volts bias for this circuit. The only reason I discarded this modulator was my lack of modulation transformer of anywhere near the right value.

Construction

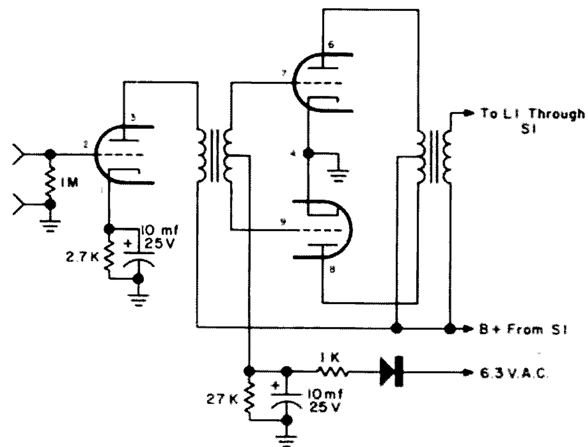
I built the rig on a 4" x 5" x 1" chassis



L-1—21T #26 enam. 7/8" dia., 13/16 long (see text)
L-2—8T #22 tinned 15/16 dia., 7/16 long (see text)
Y-1 7 mc crystal

made of scrap aluminum. The front panel is also scrap aluminum but with a coat of flat black paint and some decals added for looks. Coils L-1 and L-2 were wound on an old plastic pill bottle. The spacing on L-1 was achieved by winding two strands of wire at once and removing one after completing the coil. L-2 should be made movable so that the position for best output can be found. I did this by making a form out of stiff paper which was just large enough to slide over L-1. L-2 was then wound on this. Parts layout is not critical. Parts values are not critical with the exception of the cathode resistors on the 6U8. These should not be less than the values indicated or the plate dissipation ratings may be exceeded. The value for the excitation control, C-2, may not fall within the 3-30 mmf range in some cases, and it should be adjusted to meet the operating conditions listed later. Transformers T-1 and T-2 are products of my junkbox and I can't identify them precisely, but T-1 is a small input transformer with about a 1 to 3 ratio of primary to secondary turns. T-2 is a small output transformer with a center tapped primary. Feel free to experiment with values for these transformers, though. At one point in my trials I was using an old 400 cycle "power" transformer with fairly good results.

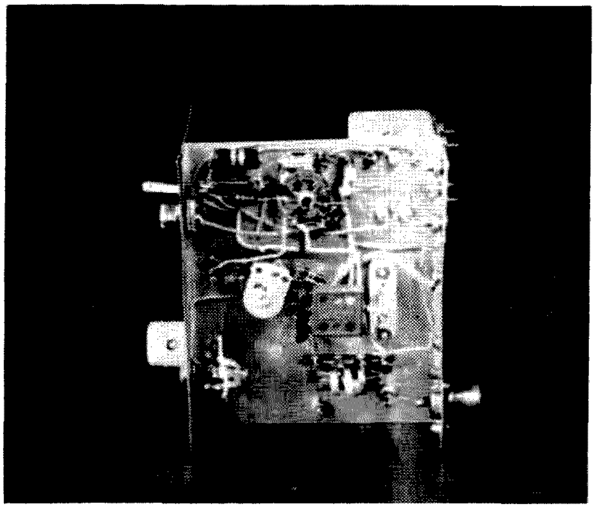
6EZ8



ALTERNATE MODULATOR

Adjustment and Operation

The best tuning indicator I have found is the S-meter on my receiver. With the transmitter key down, tune C-4 for maximum S-meter deflection. An antenna or dummy load must be connected. It the rig stops oscillating when tuning C-4 through resonance, change the value of C-2. For initial tuning place the output link L-2 just below the bottom of L-1. When the best value for C-2 is found, adjust L-2 for maximum output. The value for L-2



shown is based on using 50 ohm coax to feed the antenna.

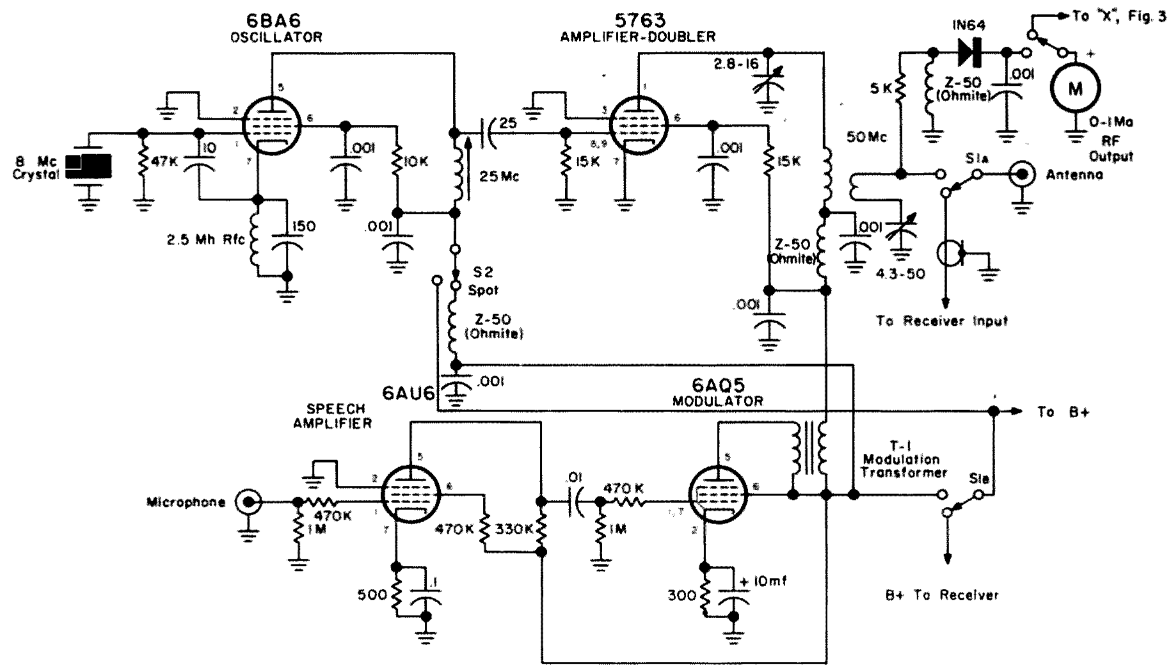
Any handy power supply may be used. Many receivers can supply the necessary values from the accessory plug. Total requirement for cw is 12 ma and for AM is 28 ma. The 6AH6 screen draws 2.5 ma from the regulated 150 volt supply. This little rig has given me excellent results. Harmonics are no problem if L-2 is adjusted properly and the modulation, though suffering somewhat from lack of audio power, is perfectly readable. With the values shown the rig can be used on 20 meters with 7 mc crystals if desired, although the tank circuit is a bit on the low C side for 20. If you want to use it on 20 meters primarily, L-1 should be cut down.

6 Meter Transmitter-Receiver

Larry Levy WA2INM

There are many transceivers and transmitter-receivers (the difference being that a transceiver has audio stages common to transmitter and receiver sections) that have one common fault—a poor receiver section. There are good reasons for this, most of them involving money (on commercial gear) and/or complications of construction (home-brew grear) of a good front end and *if* strip. For the user of commercial gear, the solution is quite simple: buy the most expensive equipment made and then you will usually have a good receiver. For the home-brewer, there are several solutions to this problem. The most economical way, and in all probability the best performing, is to use an automobile receiver as the first *if*, second converter, and second *if*. Most automobile receivers are quite sensitive, having at least one stage of rf amplification before the mixer and having about two *if* stages around 262kc, which also makes them quite selective. Any way you look at it, these are the main requirements for a good receiver. This approach does eliminate the many cases of insomnia resulting from unstable *ifs* and transformers that won't stay aligned. It also saves a considerable amount of money over the cost of individual components, as an automobile receiver can be picked up for almost nothing at any junkyard. There is an article in the September, 1962 issue of 73, by W5VOH, on doing this. I feel that I have found a more convenient and simplified method. Completely rip out the existing power supply, remove the receiver chassis from the case and discard the rest of the case. This simplified conversion not only saves considerable space and eliminates all sorts of unnecessary complications; it will also look better when the chassis is mounted in another case, along with power supply, transmitter, modulator and converter.

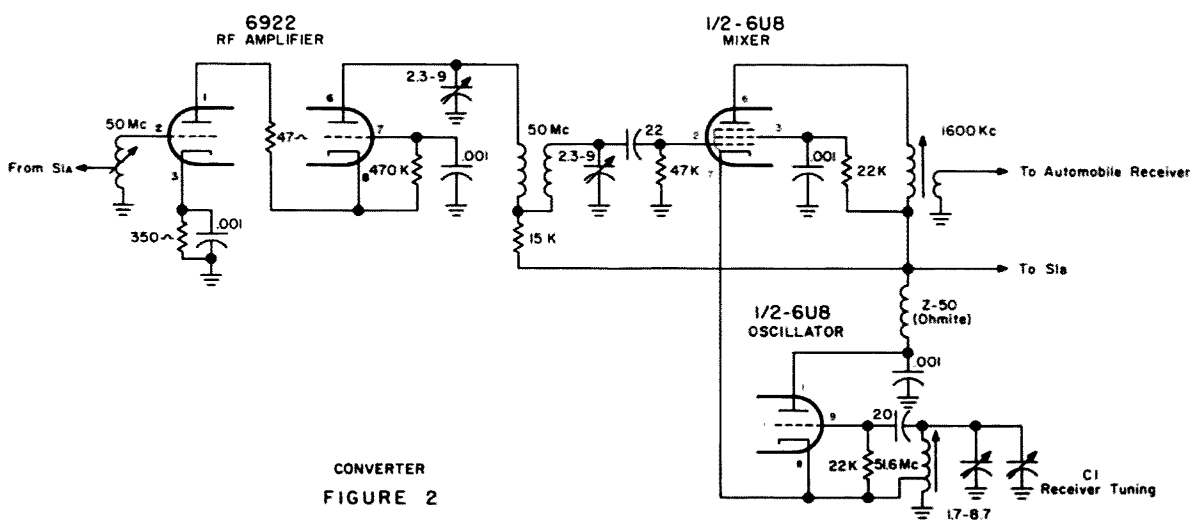
The converter is one that uses several good points of VHF design and with minor modifications would make a good low noise con-



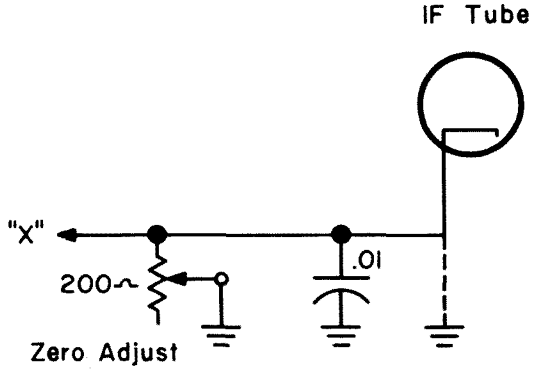
TRANSMITTER-MODULATOR
FIGURE 1

verter for a communications receiver. It uses an Amperex 6922 low noise cascode rf amplifier bandpass coupled to a 6U8 mixer. The bandpass coupling keeps the image level incredibly low considering the low frequency (1600 kc) *if* while the 6U8 mixer combines overload resistance with a low noise figure. The 6U8 is used as a tunable oscillator, tuning above the received frequency. Stability is good and I found no need for voltage regulation. The receiver tunes about 1 mc of the band with a National MCN vernier dial connected to the tuning capacitor. The output of the mixer is connected to the automobile receiver by means of a short length of coax link-coupled to the mixer plate coil. It is important that coax be used, well grounded at both ends, to eliminate the possibility of feedthrough from local broadcast stations.

The transmitter section is low powered, but not so low that it is inadequate to work stations that can be heard by the receiver. If more power is required, other tubes could be substituted in the transmitter that will increase the output several times. This does involve a larger modulator and power supply, and since this rig was built for economy, I felt that the increase in power was not worth it. The transmitter uses a 6BA6 oscillator-tripler driving a 5763 doubling in the final. This was done in the interest of economy and simplicity, and, while not completely conventional, it works



CONVERTER
FIGURE 2



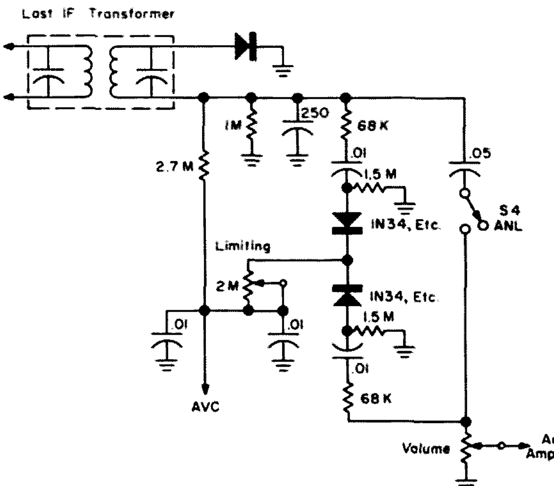
"S" METER
FIGURE 3

fine. The modulator uses a 6AU6 speech amplifier and a 6AQ5 modulator, transformer coupled to the 5763.

The power supply is a conventional full-wave supply, delivering about 250 volts at 150 ma. S1 is a dpdt switch used as a transmit-receive switch and S2 is a spdt spot switch. There is a O-1 ma meter used for measuring rf output. Although it wasn't done in the original model, it could also be used as a S-meter by connecting it to a switch and metering the cathode current of one of the *if* tubes. The lead from the cathode is ungrounded and connected to S3. If it is possible, S3 could be combined with S1 by using a 3pdt switch so that the meter is automatically switched. The S-meter will lead backwards, that is, from 1 ma with no signal towards O ma with a strong signal. If this is inconvenient, you could always mount the meter upside down and paste some kind of a scale on it.

There is not too much that is critical in the construction but there are a few precautions that should be observed. In the receiver the 6922 rf stage is a high gain amplifier and will have a tendency to go into self-oscillation unless care is taken in the layout and construction. It is important that the antenna coil and the bandpass coil be at right angles to each other and well shielded, as well as all leads going near both coils. The two capacitors used for tuning the bandpass coil should be well grounded. If the unit is laid out so that any leads (heater, power, etc.) pass near both sets of coils, they should be well shielded. The heater lead to the two tubes in the converter should be shielded and bypassed at each tube. The oscillator coil should be mounted under the chassis and in a place where there is a minimum of heat. This coil should be wound on a ceramic slug-tuned coil form, with the tap being about 1½ turns from the grounded end; the form used should have a ¼ inch diameter. A 1½-7 mmfd ceramic trimmer is mounted directly across the leads to the coil and the condensers used in the oscillator should be of the NPO variety. There were no problems encountered with stability so there was no need for voltage regulation of the oscillator. If it is desired, the oscillator could be crystal controlled and the receiver used as a tunable *if*, although the tunable oscillator method is preferred in this case. No problems should be encountered in connecting the output of the converter to the receiver or to actually get the receiver to work on AC. The only special part required in the converter is the tuning condenser which is made by removing all but one rotor and one stator plate from a 15 mmfd variable.

There aren't too many precautions that have to be taken with the transmitter because the final is doubling the frequency and therefore most of the problems usually associated with straight through final amplifiers, such as self-oscillation and other forms of instability, are absent. The oscillator coil should be kept away from the final plate leads and final plate coil. If possible, the oscillator coil should be mounted under the chassis and the final plate coil mounted on top of the chassis on the plate tuning condenser on the front panel. Care should be taken to keep the modulator leads away from the final tank leads. Shielded cable should be used for all signal carrying audio leads. It is important that neither of the 470K rf decoupling resistors are eliminated and that the grid side of these resistors have as short a lead as possible. The modulation transformer is a transceiver type transformer such as a Triad M4Z in which the speaker leads are not



AUDIO NOISE LIMITER
FIGURE 4

used. A push-pull audio output transformer will work fine, although it will probably result in some kind of impedance mismatch.

The units described can be built on sub-chassis and mounted in a case large enough to hold the automobile receiver chassis and the various sub-chassis necessary for the complete transmitter-receiver. After everything is mounted, the control circuits are wired as well as the cables and power leads interconnecting the various units. When doing this work, it is a good idea to make the leads long enough so that any unit can be pulled out for repairs without having to unwire the complete transmitter-receiver.

The next step is the conventional smoke test. This consists of applying power and noting where smoke is coming from, such as burning resistors, smoldering wiring, exploding electrolytics, etc. Once these conditions are corrected, the next step is tuning the transmitter. The transmitter tuning is quite simple, the only adjustments necessary is to tune the oscillator coil for maximum drive and peak the final tank for the largest deflection of the output meter. It might be helpful to use a #47 pilot light as a dummy load for checking the modulator. The bulb should get considerably brighter when you speak into the microphone. It will be necessary to have a high outputa crystal microphone to use with this modulator as there is not much extra gain. If more gain is desired, an extra audio stage, similar to the speech amplifier stage, can be added.

To get the receiver operating properly, it is first necessary to have the *ifs* aligned and be sure that the front end is tuned to 1600 kc and peaked. Use a strong signal around 50 mc and tune the oscillator until it is received. Peak the mixer plate coil for maximum signal strength and tune the antenna trimmer in the car radio for the same. Next tune the antenna coil in the converter and the first bandpass capacitor for maximum. Use another signal near 50.5 mc and peak the other bandpass capacitor. Now take a signal about half way in frequency between the previous two and peak the antenna coil. Now retune the bandpass capacitors using 50.1 and 50.5 as alignment frequencies, one capacitor to each frequency. Care must be taken in alignment as some of these steps are interacting and should be done in this order. Tuning the bandpass circuits will probably have the tendency to pull the oscillator frequency slightly so be sure that the signal is returned during peaking. After these steps are completed, the oscillator frequency can be set and the receiver calibrated.

The rig should now be ready for use on the air. One of the first contacts made with the station was over 300 miles away with S7 reqports on both ends. It is also quite easy to make skip and extended ground wave contacts reliably. The receiver is one of the best I have ever used in a rig of this type and compares favorably in sensitivity, selectivity, and noise figure to many communications receivers, including my own, with its nuvistor converter. With a nuvistor preamplifier, I am sure that the noise figures would be equal, although the measured difference was less than 1 db.

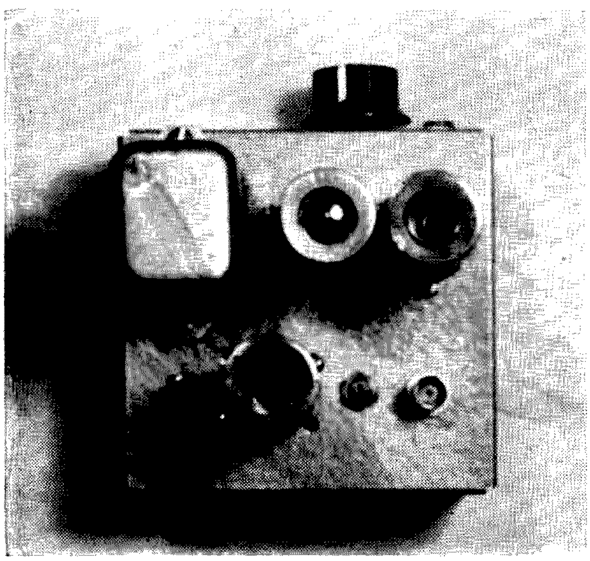
With all of these features, the rig can be made for less than $25, assuming that you are fortunate enough to talk the properieter of the local junkyard out of an automobile receiver at a reasonable price. There are many possible modifications of this idea that can be used. It is possible, for example, to add push-to-talk by replacing S1 with a relay. The rig can also be modified for different bands by just changing some of the coils. The transmitter and converter could be built into a small box and connected to an existing automobile receiver in a car and used as a high performance mobile station, after a modification of adding a noise limiter is made to the automobile radio. While on the subject of noise limiters, none was included in the original design. From my location, near the top of Hogback Mountain, Vermont (a favorite location for hilltopping), the signals are strong enough and the college is far enough away from the main road so that ignition noise is so rare that no limiter is necessary. For those who would like to install a noise limiter, the circuit modifications necessary are shown in Fig. #4. The diodes can be any general purpose diode, providing they are both of the same type. Diodes having a high forward to reverse ratio will have the most effective limiting characteristics. The limiting control should be adjusted for maximum limiting without distorting the received signal. Adjustments should be made to set the limiting to the point of distortion and then back off slightly. This operation should be carried out on a reasonably strong signal as if it is done on a weak one, it will tend to distort on strong stations due to the non-linear avc characteristics of automobile receivers.

There are several things that can be done to improve the appearance of the rig, such as spraying the panels, using illuminated meters, decals, etc. If care is taken in construction, the result will be a rig that will far outperform comparable commercial equipment, be just as attractive, and cost a small fraction of the price of store bought gear. . . . WA2INM

A novel approach to

50mc DSB

Will the author of this article please identify himself?



Those of you who are experimentally inclined will, undoubtedly, be interested in this unique double-sideband balanced modulator.[1]

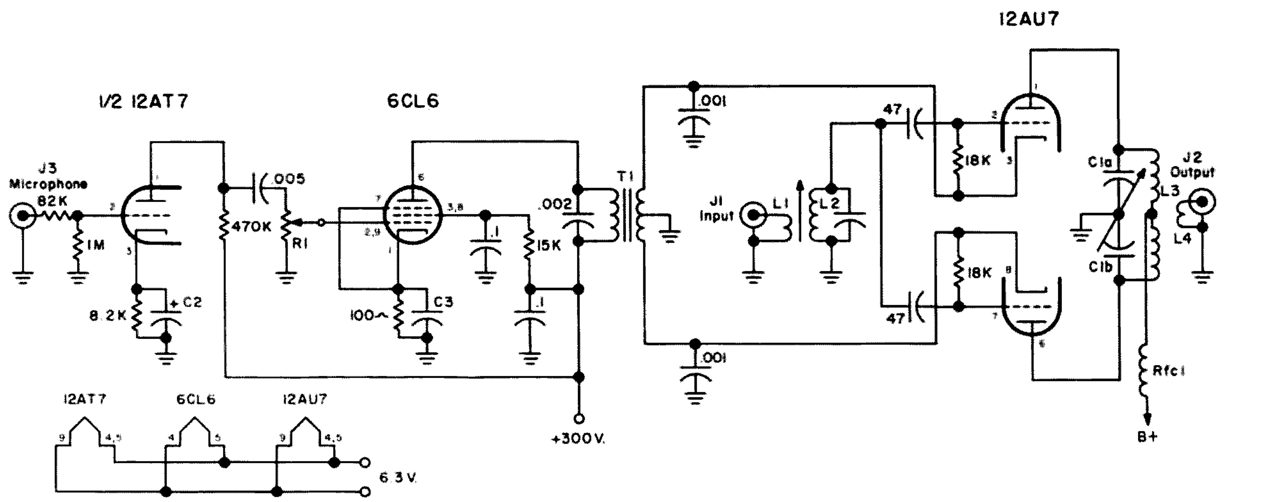
The double-sideband balanced modulators most of us are familiar with generally utilize two pentodes operating in push-push, with the audio signal applied to the screen grids. The balanced modulator, to be described, differs from this in that it utilizes a twin-triode with the audio signal applied to the cathodes.

From a quick glance at the schematic it will be obvious that no B plus power supply, as such, is used for the balanced modulator.

Operation

A low level 50 mc signal is applied to the

[1] **Better Double Sideband,** Cameron, CQ, March 1959, page 28.



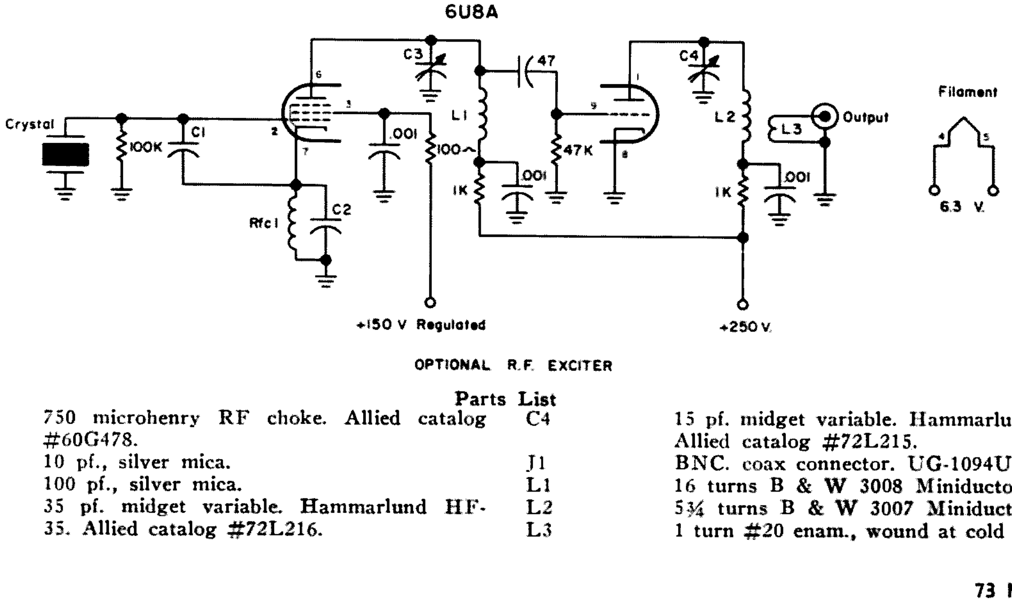
Parts List

R1	500 k pot. Allied Catalog # 30 M 322.	J3	Microphone jack.
C1	Butterfly variable capacitor: 26 pf. per section. E.F. Johnson 167-22. Allied Catalog number 75L927	L1	1 turn #20 enam., wound at cold end of L2.
		L2	10 turns 24 enam. ½" long, wound on ¼" diam., powdered iron core, slug tuned form.
C2	1 Mfd., 100 volts. Allied #11LO26	L3	10 turns #20, ½" diam., ¾" long, center-tapped.
C3	35 Mfd., 50 volts. Allied Catalog #16L662.		
RFC1	8.2 microhenry R.F. choke. Allied catalog #60 G 439.	L4	10 turns #24 enam. ½" long, wound on ¼" L3.
J1, J2	BNC connector: UG-1094U.	T1	Audio transformer.

parallel connected grids of the 12AU7. However, unless we are modulating, there is little or no potential difference between the cathode and plate of either section, therefore the tube cannot conduct. Now, when we modulate, an audio voltage will be applied to the cathodes of the 12AU7 through transformer T1. At any instant of time, one triode section will see the positive half cycle of the audio signal at its cathode and the opposite triode section will see the negative half cycle. The triode section that is seeing the positive half cycle will not conduct because its cathode is more positive than its plate. However, at this same instant of time, the opposite triode section's cathode is seeing the negative half cycle and it becomes more negative than its plate. Now, if the cathode is more negative than the plate, the plate may be said to be less negative, or more positive, than the cathode. Under these circumstances the tube will conduct. The dc power input, at any instant, is equal to the potential difference between plate and cathode, at that instant, multiplied by current flowing through the tube at that instant.

As you see, from the preceding, the power for the balanced modulator is actually derived from the audio signal.

While this method of double sideband reduced carried generation is different, it certainly has more than just that to recommend it. This circuit has the tremendous advantage



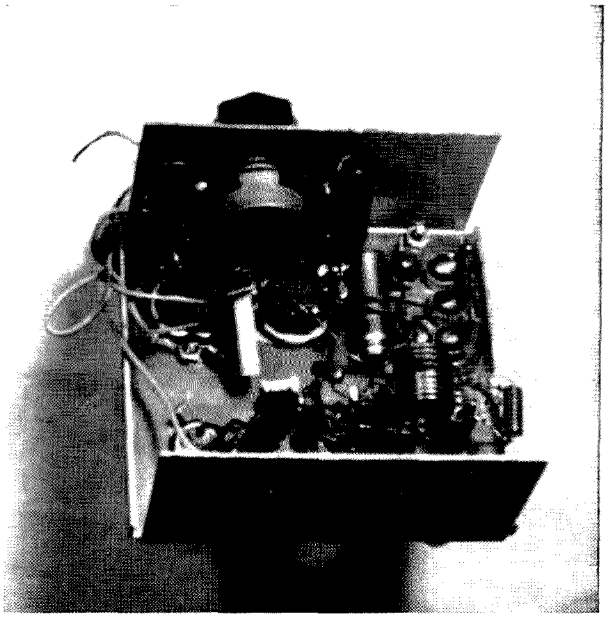
OPTIONAL R.F. EXCITER

Parts List

RFC1	750 microhenry RF choke. Allied catalog #60G478.	C4	15 pf. midget variable. Hammarlund HF-15. Allied catalog #72L215.
C1	10 pf., silver mica.	J1	BNC. coax connector. UG-1094U.
C2	100 pf., silver mica.	L1	16 turns B & W 3008 Miniductor.
C3	35 pf. midget variable. Hammarlund HF-35. Allied catalog #72L216.	L2	5¾ turns B & W 3007 Miniductor.
		L3	1 turn #20 enam., wound at cold end of L2.

of being capable of delivering much better sounding audio than one generally hears from double sideband transmitters.

The power output of this balanced modulator is low, and while you could operate it "barefoot," it will give far better results if it is used to drive a low power linear amplifier. Its output is sufficient to drive a class "A" 6CL6, 5763, or equivalent type tube.



An rf exciter is not shown in the schematic (although the schematic of an optional RF exciter unit is provided elsewhere in this article for those who may need it) as I used the buffered 50 mc output of my VFO to drive the balanced modulator. Any low powered 50 mc exciter will serve the purpose equally well. One word of caution: if you should use a 50 mc overtone oscillator to drive the balanced modulator, I would strongly recommend the use of a buffer stage between the oscillator and the balanced modulator. This will provide some degree of isolation and lessen the chances of pulling the oscillator frequency when modulating. Pulling of the oscillator frequency would make it extremely difficult for another operator to tune in the signal on his receiver, as anyone who has ever tried to tune in an unstable SSB signal can attest! It goes without saying that the power supply for an overtone oscillator should be voltage regulated.

The layout is not critical, although some care should be taken to maintain symmetry in the balanced modulator. The cathode bypass capacitors of the 12AU7 balanced modulator should be mounted as close to the tube socket as possible, with short leads. These capacitors provide an rf ground return for the cathodes

of the 12AU7, but they also control the frequency response of the audio by clipping the highs.

The gain of the audio section is fairly high so a little care should be exercised here to prevent audio feedback in the amplifier as well as rf feedback into it. No trouble was experienced along these lines, but the possibility exists if one is not careful.

Neutralization of the balanced modulator is unnecessary. Being a push-push stage, it is inherently self-neutralized. No trouble with parasitic oscillations was encountered.

This DSB generator is very flexible and its design leaves room for many variations and ideas the individual constructor may want to experiment with. A few things that might be added are: Speech clipping, VOX, linear amplifier, etc.

The entire unit was constructed on a minibox chassis measuring: 4" x 4" x 1½". This can be altered to suit the desires of the individual.

VHF Contest Special

A dissertation on the use of the Corner Reflector on 144 mc

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Valparaiso Technical Institute
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When the author undertook the construction of this particular antenna, it was with the thought in mind of producing a low cost, moderate gain, easily portable antenna for use in VHF parties. As it turned out, the antenna performed far beyond our wildest expectations and was surprisingly easy to build and match. This article is primarily concerned with putting this antenna on 144 mc, but data will be given which will enable the interested builder to construct it for any desired frequency band.

I must confess that when K9HYV first cornered me and mentioned building this antenna, I had my doubts about it ever comparing with a good yagi. The gain figure given by Dr. Kraus [1] in his fine book was only about 10.2 db for a 90 degree corner, which we had decided on due to size and portability requirements. However, the broad front lobe of the radiation pattern seemed to have a very desirable characteristic in that most portable set-ups generally use the "armstrong" method of rotation and any time saved in running back and forth to the mast is pure gold. So, with reservations in mind, we decided to try one of these beasts and compare it with a commercial 10 element yagi which was already in the sky at K9SGZ.

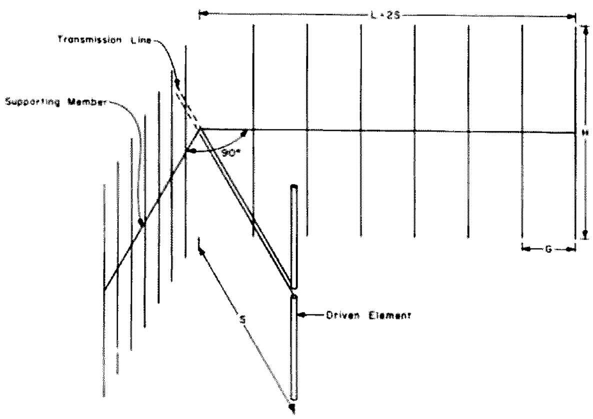


FIGURE 1

Our first problem was with the dimensions to be used on this 90 degree corner. We decided to use RG/11U coax, as we had some on hand, so consulting the graphs in Kraus we find that the dimension "S" (Fig. 1) should be about .35 wavelength to provide a terminal radiation resistance of 72 ohms. If 52 ohm coax, such as RG/8U is used, a dimension "S" of about .32 wavelength will give an excellent match. The length of the supporting members is then determined to be at least "2S." This is a minimum dimension, but any larger figure will give very little improvement, if any. The length of the reflectors, H (Fig. 1) is then determined to be equal or greater than 0.6 wavelength, and the spacing between re-

[1] Kraus, Antennas, see Radio Bookshop #5.

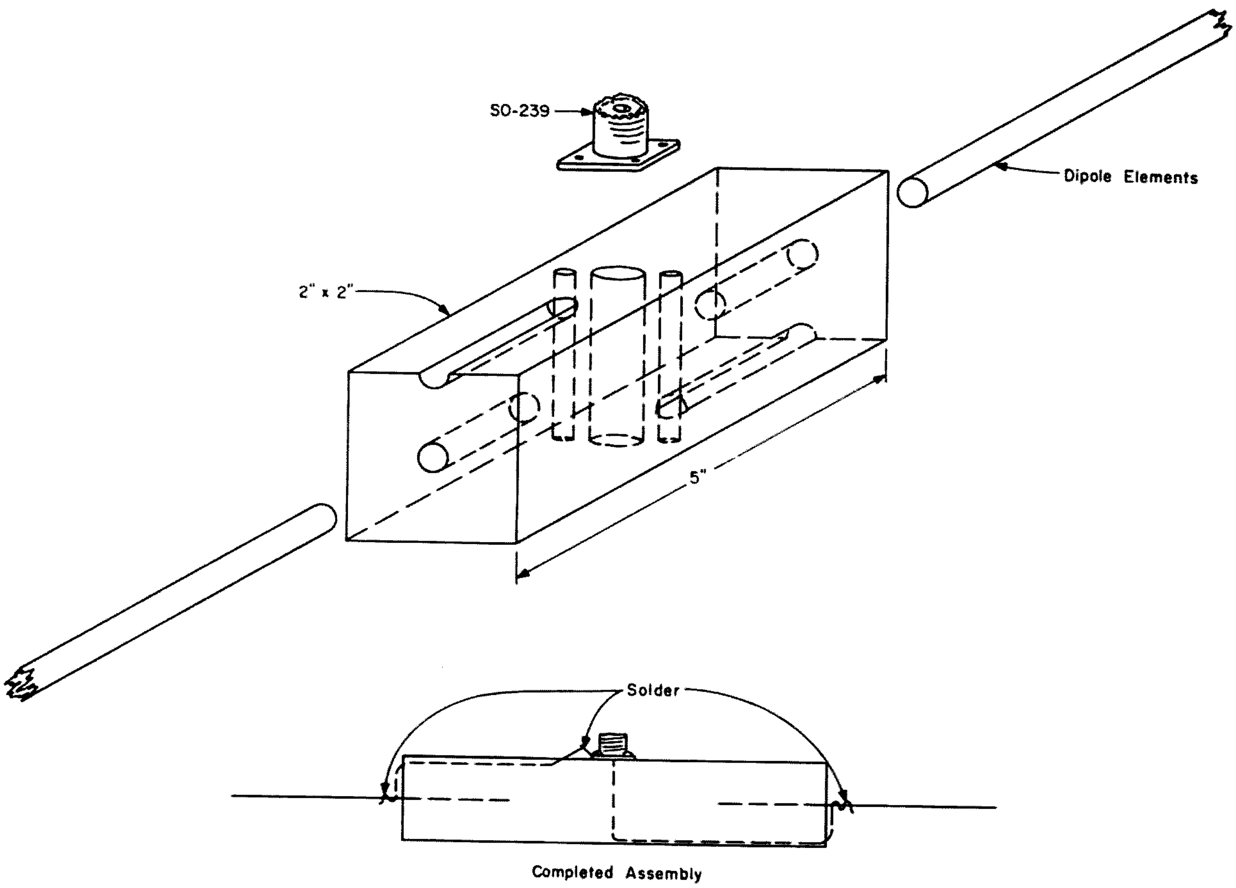
flectors, G, should be 0.1 wavelength or less. These last two dimensions are not at all critical, and are only guides to be used to find out how little wire needs to be used for reflectors. A table of dimensions follows, for use at 144.5 mc.

Dimension (Fig. 1)	length in inches
S	28½
2S	57
G	8
H	49

It should be noted that these dimensions will allow the use of this antenna over the lower two megacycles of the two meter band with very little degradation. The bandwidth of the corner reflector is approximately 60% of the center frequency, which is quite a drastic change from the very critical dimensions of the popular yagi style.

Thusly armed with the dimensions, a yardstick, hacksaw, etc., we attacked the monster with vigah. Our first try was made completely out of aluminum, but 2 x 2's seem to be the more logical approach. The first step was to unroll and straighten the 57 feet of aluminum clothesline wire needed for the reflectors. We used the old trick of tying one end to the car frame and the other to a convenient tree, then just a slight pull, and *voila,* straight wire. After cutting up the 14 reflectors needed, the supports were readied for assembly. Two pieces of 2 x 2, each about 57 inches long, are drilled every eight inches with a hole which just allows passage of the aluminum wire you choose for reflectors. Another hole is then drilled into each of the reflector holes, but at right angles to the reflector holes. These allow wood screws to be tightened down on the reflectors to hold them in place when they are inserted in the holes. Two holes are also drilled at this time, one in each support, for the bolts which will hold the antenna to the mast. These should be about 39½ inches from the vertex of the angle formed by the two supports. The two supports are then given a coat of varnish for weather protection and are fastened together at the vertex by an ordinary cabinet door hinge.

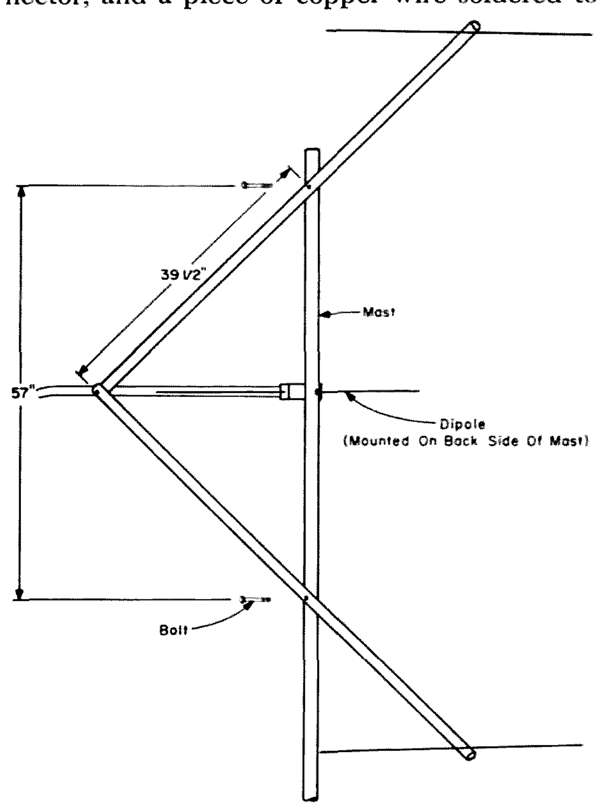
The mast is next readied for assembly. A short piece of mast which will mate with the mast from the top of your tower may be used here. Six feet of mast will do nicely for 144 mc. Two holes are drilled in this mast to accept the bolts which go through the large holes in



DIPOLE MOUNTING DETAIL
Figure 3

the two wooden supports, and should be 57 inches apart, spaced as near the top of the mast as possible. Midway between these two holes, mounting holes for the driven element should also be drilled at this time. The nature of these holes will depend upon the method of supporting the driven element. This will be discussed shortly, but will undoubtedly be pretty much an individual thing, depending upon the kind of junkbox or wallet available. Once these are drilled, the mast may be assembled to the supports with two bolts, such as ¼" carriage bolts. The mast and supports are then laid aside and the driven element construction is undertaken.

As may be seen from Fig. 1, the driven element is an ordinary dipole, although a folded dipole may be used if desired. If a folded dipole is used, the conductor ratio should be 1 to 1 for 300 ohm feedline. The dipole is made of ⅜ inch copper tubing which may be purchased at plumbing supply stores. For a support, I used a block of 2 x 2 about 5 inches long or so, and mounted an SO 239 connector on one side (see Fig. 3). Slots are cut in both sides and a ¼ inch hole is drilled through the center of the block. The ends of the block are drilled to a depth of about 2 inches with a drill bit slightly smaller than the OD of the dipole copper tubing so that the tubing will have to be forced into the holes. This makes a very rigid mount for the tubing. The SO239 connector should have a piece of copper wire soldered to the inner conductor before the connector is mounted on the block. Wood screws will make a good job of the connector mounting. The copper wire soldered to the inner connector is placed through the hole in the center of the block and then run down the slot on the opposite side of the block to one end of the block. A ground lug is placed under one of the wood screws which mount the connector, and a piece of copper wire soldered to



ASSEMBLY DETAIL
(Reflectors Omitted For Simplicity)

FIGURE 2

the ground lug. This wire runs down the slot on the connector side of the block to the other end of the block. Solder should be flowed over the ground lug and connector to insure a weathertight joint. Next, the copper tubing is forced into the holes in the ends of the block and the copper wires soldered to the tubing. The two pieces of copper tubing should be about 21 or 22 inches long so that they can be "pruned" for best match. If no SWR bridge is available, cut the tubing off so that the overall dipole length is about 38½ inches.

Two holes may now be drilled in the block as shown in Fig. 3 to pass stove bolts used for mounting the block to the mast (see Fig. 2). A coat of varnish should be applied to the block and solder joints at this time for weather protection.

All that now remains is to mount the dipole to the mast and insert all the reflectors into the supports, apply energy to the dipole through the feedline you intend to use and prune the dipole for best SWR using a bridge. An SWR of less than 1.2 to 1 should be easily obtained. In our case, the SWR was below 1.1 to 1 using a Johnson bridge. The antenna does not have to be on the tower when this pruning is done, but should be at least 4 or 5 feet off the ground. The shielding effect of the reflectors makes a simple job of this. Put it up in the air, and you are ready to go with a very fine antenna.

Several checks were run with this antenna at the same height as a commercial 10 element yagi, and signals were as good in *all* cases, and as much as 2 s-units better in some cases using the Corner. It is believed that this is attributed to the very low angle of radiation obtained with this antenna. Most people won't believe this, but comparisons show it to be true.

The real merit of this antenna is when it is used during contests. Just point it in the general direction you wish to work and *forget* about it. The front lobe is so broad that you can cover easily a 45 degree area in the front lobe with so little degradation that you will soon quit trying to "peak it up" on a signal. The front to back ratio, measured on a Collins receiver at about 20 miles distance is about 25 db, and there are no minor lobes which are stronger than the back lobe. It is just an all around excellent antenna, and at this QTH the yagi is a thing of the past. It was compared with a 50 element Long John Yagi at W8BPG and put up a good showing against the monster.

My most sincere thanks to K9HYV for the prodding it took to get this thing built, and for showing just how good an antenna can really be. Give it a try, and you will surely be as pleased as we are. CU on two.

. . . K9SGZ

The VR Tube

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Cambridge 38
Massachusetts

A source of regulated voltage is often required for such circuits as vfo's, receiver hfo's and bro's and other sensitive equipment which must be stable in operation, as well as for amplifier bias and screen grids. The methods used in achieving this voltage stability range from the use of oversized power transformers with large bleeder resistors and filter output capacitors to highly complex systems using variable regulating elements controlled by the variations in demand on the supply.

There are two main types of voltage regulators; the series regulator and the shunt regulator. These are shown in Fig. 1. The series regulator acts a a resistor which varies in inverse proportion to the load; the greater the demand on thet supply, the less the resistance of the regulator element. The series regulator, however, requires a device to sense a voltage difference in the output and apply this signal to the regulator element, and there is inherently more complex than the shunt type. The shunt regulator, on the other hand, has a single constant voltage drop across it, this voltage drop being the output voltage.

The regulator elements used in series regulators are of necessity vacuum tubes or transistors. In the shunt regulator, however, they may be either vacuum tubes, transistors, zener

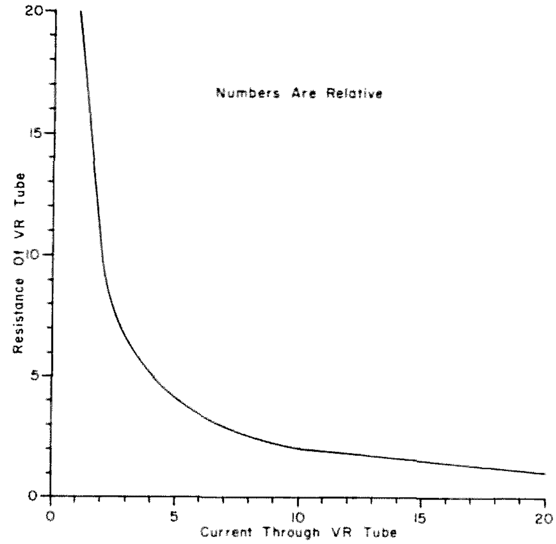


FIGURE 2

diodes or voltage-regulating tubes. The first two will still require a feedback system to sense changes in the output voltage, but the zener diode and the VR tube do not need this. Of these latter two regulating elements, the VR tube is best suited to power supplies for vacuum tubes, owing to its high voltage range and lower cost as compared to zener diodes of the same voltage.

VR tubes are diodes containing inert gases such as neon, krypton, xenon and argon to provide several voltage levels. When sufficient voltage is applied to the tube, the gas ionizes, and its resistance is inversely proportional to the current flow through the tube, as shown in Fig. 2. When ionized, VR tubes emit a soft glow, and this glow may be used as an indication of conduction. As you will see in the graph in Fig. 3, the current range over which the voltage is constant is limited, at its lower extremity by the loss of conduction, and at its upper by the transition to the abnormal glow and arc discharge stages, neither of which are suitable for voltage regulation.

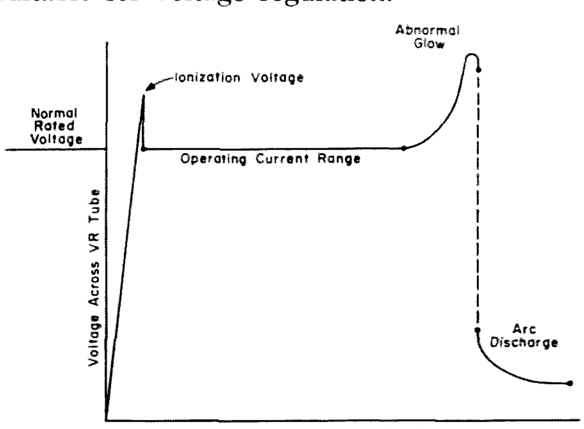
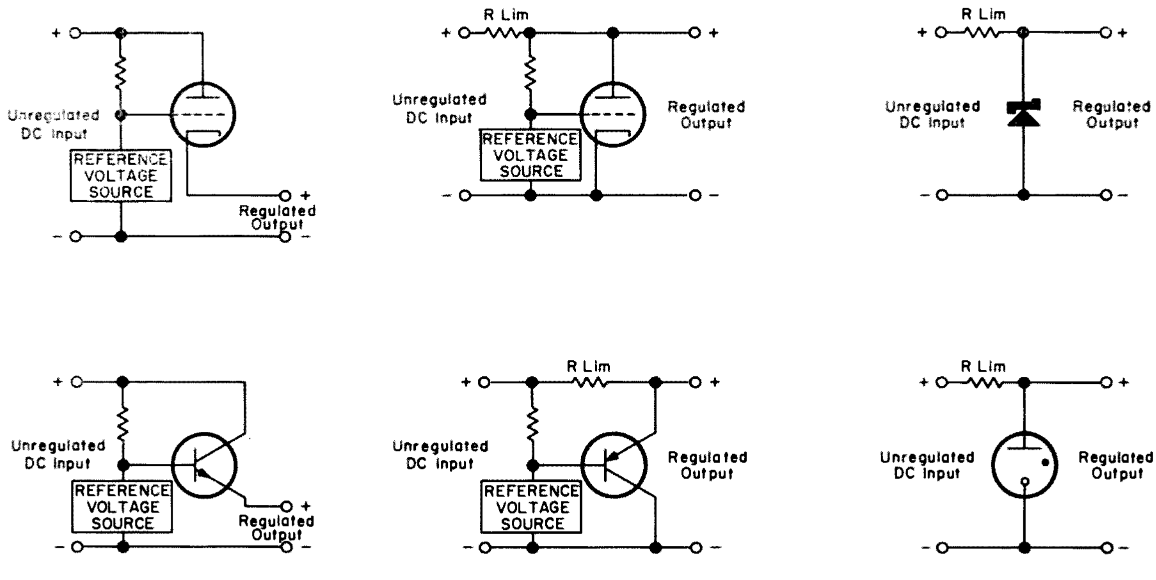


FIGURE 3



SERIES REGULATORS

SHUNT REGULATORS

FIGURE I

Since the resistance decreases as the current through the tube increases, it stands to reason that the current drawn through the tube would eventually build up to such a value as to destroy it. Therefore a limiting resistor is placed in series with the tube to hold the current to safe values. The value of this resistor may be calculated by the following equation: $R_{lim} = \frac{E_{sup} - E_{vr}}{I_{vr}}$ where E_{sup} is the supply voltage, E_{vr} is the rated VR tube voltage and I_{vr} is the maximum VR tube current. The limiting resistor may also be calculated for smaller values of VR tube current, the current being equal at least to the minimum VR tube current plus the maximum load current. Thus, when the load is drawing no current, the current through the VR tube will be equal to the minimum VR tube current plus the maximum load current, but when the load draws full current, the current through the VR tube is at the minimum required to maintain conduction. Obviously, the limiting resistor may be set so that the VR tube-load circuit draws the maximum current that the VR tube can handle, but it is not always necessary. VR tubes may also be used to regulate voltage at currents much greater than the tube can handle, provided that the load current *variation* does not exceed the rating of the tube. When using the tubes in this way, care must be taken not to disconnect the load while the circuit is on, or else the total load current will try to get through the tube, thereby destroying it.

As was seen in Fig. 3, the starting voltage is somewhat higher than the tube operating voltage. Also, the limiting resistor voltage drop makes it necessary to have the supply voltage somewhat higher than the operating voltage. Generally, the supply voltage should be about

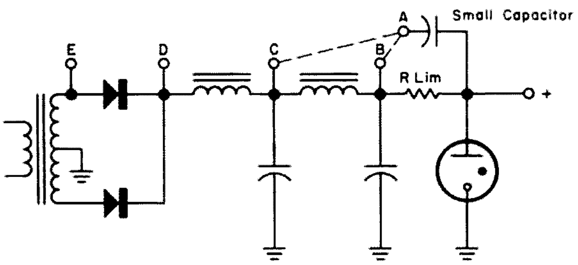


FIGURE 4
The small capacitor bypasses some of the ripple voltage (or surge voltage when supply is turned on) around the limiting resistor, thereby adding to the VR tube starting voltage. Obviously, the ripple voltage is highest at point "E." The capacitor will work even at point "B" under certain conditions.
As the "blank" pins of the tube protrude into the envelope, it is sometimes possible to connect the capacitor to these instead, thereby creating a supply of ions in the tube and making it easier to ignite.

1.3 times the VR tube voltage. At this point it might be mentioned that VR tubes are sensitive to light and radiation, and that a tube which will be used in the dark should be in the dark while its limiting resistor is adjusted, otherwise it may not start when placed in service. This fault may be overcome by giving a margin of safety in the choice of supply voltage. Nowadays many VR tubes have a bit of radioactive isotope inside which makes for more reliable starting. Also, in case of difficult starting due to insufficient supply voltage, some of the tricks shown in Fig. 4 may be used.

Fig. 5 shows the various types of VR tubes available. Type 5651 is generally used only as a voltage reference element in vacuum tube shunt or series regulators, as its voltage output is extremely stable, although the current is very low—in the neighborhood of 3 ma maximum. Type 90C1 is made by Mullard and Amperex, and is not as common as some of the others. The OC2 appears to be made only by Raytheon and RCA, while the others are generally available.

The VR tube has its own built-in safety interlock to prevent unregulated voltage from reaching the supplied circuit when the tube is out of its socket. As can be seen from the base diagrams in Fig. 5, the octal based VR tubes have a jumper between pins 3 and 7 which can be used to break either the AC power to the transformer or the DC supply to the tube itself. The latter is the better method if one is going to do a lot of experimenting with the rig, since the tube filaments do not go off when the VR tube is pulled. On the 7 pin miniature based VR tubes, each element has several pins connected to it. One simply connects the supply voltage to one pin and takes the regulated voltage from another. Then, when the tube is pulled, the supply voltage is cut off from the output.

Various VR tube circuits are shown in Fig. 6. In general these are self explanatory, but a few words of caution might be in order: do not forget that in a series string the supply voltage must be 1.3 times greater than the *total* of the VR tube voltages. Also, it should be noticed that all current that goes to the lower tubes must pass through the upper ones, and that therefore the total load current on the entire series string must not exceed the maximum current of any single tube (with the exception that the current drawn at the top of the string may be greater than the tube's maximum current provided that the maximum current variation does not exceed the difference between the maximum tube current and the current already being drawn by the rest of the load plus the minimum tube current).

For greater current handling capacity when the load current must vary over a range greater than that of the VR tube, tubes may be connected in parallel. To prevent one tube from getting all the current and thereby being destroyed, we have to insert current equalizing resistors of between 50 and 1000 or more ohms in series with each tube, as shown in Fig. 6. It must be recognized however, that the fixed equalizing resistors will have a varying voltage drop across them as the current through the tubes varies, and that the regula-

Base "A"
7 Pin Miniature

Base "B"
Octal

FIGURE 5

Type	Base	Minimum Supply Voltage	Operating Voltage	Operating Current Range	Approximate Price
OA2 6073*	A	185	150	5 - 30 MA	$1.45
OA3/VR75	B	105	75	5 - 40 MA	$1.55
OB2 6074*	A	133	108	5 - 30 MA	$1.45
OB3/VR90	B	125	90	5 - 40 MA	$1.65
OC2	A	105	75	5 - 30 MA	$1.50
OC3/VR105	B	135	105	5 - 40 MA	$1.50
OD3/VR150	B	185	150	5 - 40 MA	$1.45
90C1	A	125	90	1 - 40 MA	$2.25
5651	A	115	87	1.5 - 3.5 MA	$1.85

* Special rugged version

Fig. 5 — VR tubes available

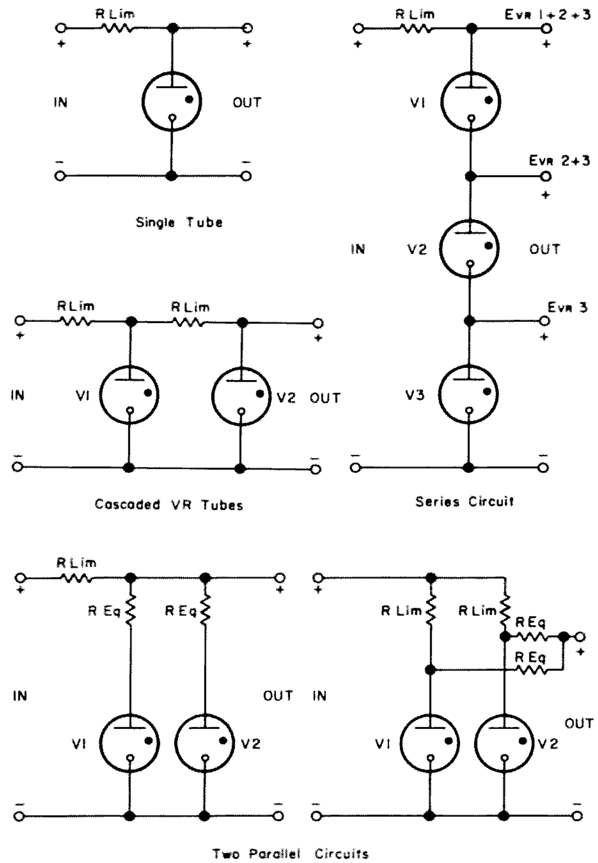
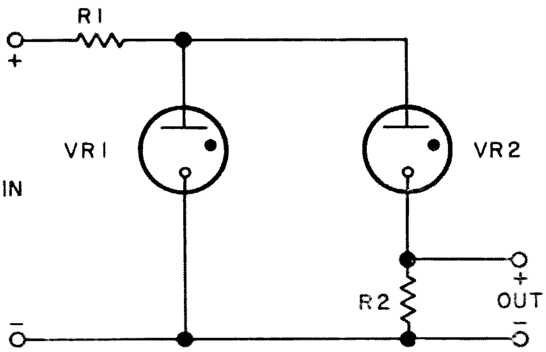


FIGURE 6

tion will not be as good as that of a single tube.

For greater stability, one may use the cascade circuit. In this circuit, the second VR tube obtains its supply voltage already regulated by the first tube. This means that the output tube is relieved of the necessity to regulate with respect to the varying supply voltage. It should be noted that the second limiting resistor *is* necessary. It should also be realized that the input tube has to have a higher voltage rating then the output tube in order that the latter may ignite.

All the VR tube circuits mentioned so far have been for equal to or greater than the rated voltage of the tubes. There is, however, a way to get low values of regulated voltage from VR tubes. This circuit, called the differential circuit, utilizes the difference in voltage between two different VR tubes, and is shown in Fig. 7. As you may notice, it's a variation of the cascade circuit mentioned above. The output voltage is taken from the top and bottom of the second stage limiting resistor, and may be as low as three volts. It should be pointed out that the second VR tube should have the lower operating voltage. It may be possible to get even lower than three volts by choosing two tubes of the same nominal volt-



Differential Regulator

FIGURE 7

age rating, but with slightly different actual operating voltages. The formulas for determining the resistors are as follows:

$$R_1 = \frac{E_{sup} - E_{vr1}}{I_{vr1} + I_{vr2}} \quad \text{and:} \quad R_2 = \frac{E_{vr1} - E_{vr2}}{I_{vr2}}$$

While all the circuits shown in this article have the cathode at ground potential, there is no reason why one cannot have the anode at ground potential. This is, in fact, necessary when constructing a bias supply. Also, since the limiting resistor does nothing but limit current, it may be put between the cathode and ground, as well as between the anode and the supply voltage. When doing this, it must be remembered that the output voltage is taken from the top and bottom of the VR tube, *not* from the top of the VR tube and ground, and that the output voltage is isolated from ground by the limiting resistor and therefore cannot be grounded.

Like all things, VR tubes have some disadvantages. Probably the greatest of these is the lack of a great variety of standard voltages, such as are available with zener diodes. This is a minor grievance, however, when one considers the cost of a 100 volt zener capable of regulating voltage at a current of 40 ma. Therefore, until the price of zener diodes is brought down to earth, the VR tube is here to stay. When one realizes its limitations, it becomes a very useful device. . . . Lyman

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(W2NSD from page 4)

Rule Making

While I believe it would have been a lot more honest for the ARRL to have asked its members their opinion before they went ahead dictatorially and presented a petition to the FCC requesting sweeping changes in our regulations, I am more appreciative than ever of our democratic form of government which permits us all to have a say in this matter while the FCC is considering it and before it can be made into law.

It is always possible that the FCC may sit on this petition as they have many others in the past, however the political connections of ARRL President Hoover might well lubricate the normally sticky wheels of beaurocracy and surprise us.

I, for one, intend to oppose the ARRL position for a return to the old Class A system of licensing. While I agree with the ARRL that it would be beneficial for us to increase our technical knowledge standards, I disagree with their growing list of rationalizations for this and their Socialistic method of achieving it. It seems to me that they are tryng to get the government to legislate a cure for a difficulty that they are in a large measure responsible for.

Though I do not subscribe to the old saw that President Hoover led the U. S. into the Great Depression, I am seriously worried that Herb Jr. may be unwittingly leading amateur radio into a depression from which it may never recover. I cannot believe that the small group that is advising him have thought out the ramifictaions of their attempt to recapture the past.

RM-499

Though I'd like to print the QST petition to the FCC for restricted voice bands in its entirety for those readers who may not have read this long, tedious and predictable document, I won't because it goes on and on and on, filling over three pages of QST with mice-type. It is all there on pages 66 and following in the November QST.

After reading through all that marshmallow-like prose I had to go back and read it again in disbelief . . . sure enough, they never at any place gave any justification for their petition. They start out by quoting the FCC's regs, 12.0, Basis and Purpose. They inform the FCC that

(Turn to page 71)

432mc Exciter from the ARC-27 RF Subassembly

Leroy May W5AJG/AF5AJG
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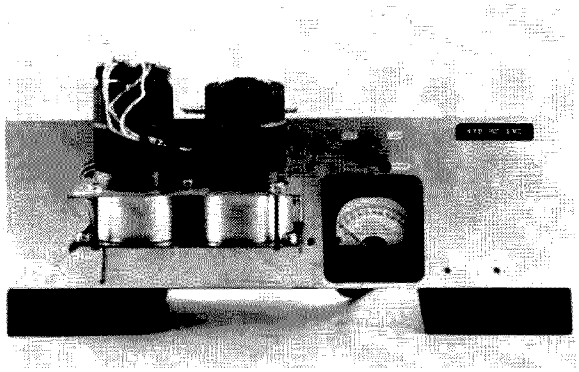
Photos by: Jim Dungan, KRLD, Dallas, Tex.



Front panel view of the Collins ARC-27 power amplifier subassembly. A small surplus double blower is mounted on the panel and blows air thru cut-outs to cool the tubes. The plate meter and its switch are shown.

Now that the RT-178/ARC-27 aircraft transmitter-receiver equipment is beginning to show in the surplus houses and junk yards, the UHF boys are beginning to make use of its innards. This compact unit was, and probably still is, widely used for air to ground communications in the region of from 225 mc to 399.9 mc. It was built by Collins and contains a veritable warehouse of UHF parts that will be eagerly snapped up by the 432 mc gang.

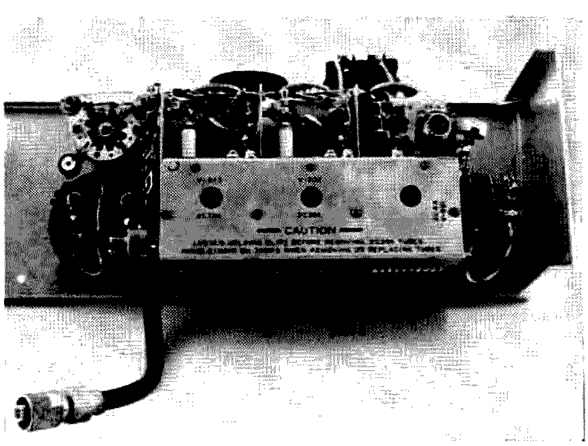
Since the frequency range will cover both the 220 mc and the 432 mc ham assignments, with just a bit of doing, portions of the unit can be used in various capacities in both these bands.

Here we will concern ourselves wtih the 432 mc transmitting portion of the equipment and a few words will be said regarding the modest modifications to be made to convert it into a very nice exciter or low powered driver for a larger 432 mc final, or even for use as a transmitter by itself on this band.

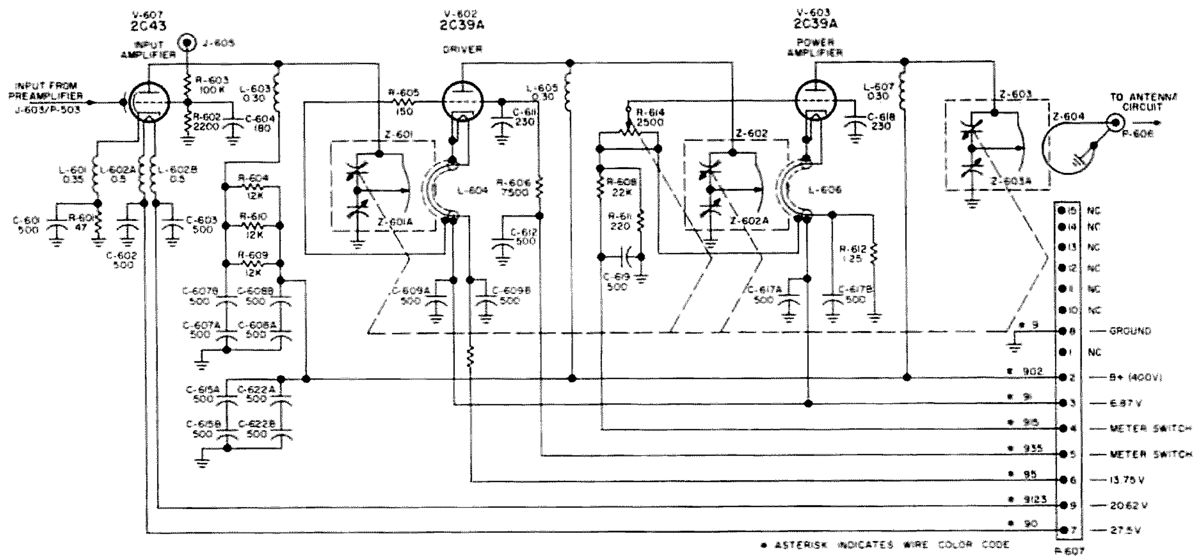
The Collins part number of the power-amplifier subassembly is 505-3506-006 and this assembly contains three tubes, namely, one 2C43, and two 2C39A's. Originally, the 2C43 was called an input-amplifier and accepted the drive from a so-called transmitting pre-amplifier. This particular stage worked on the final frequency, that is from 225 mc to 399.9 mc. This tube drove the driver, which in turn drove the power amplifier, both the latter two tubes being type 2C39A's.

The instruction book rates the output of the transmitter at 10 watts maximum and the minimum or lower limit at 2 watts. As amateurs, we can really beat the heck out of these figures, and not even cheat. Since we will be operating this particular version at a single frequency of 432 mc only, much greater power and efficiency may be obtained, since the original wide tuning range and need for constant power output efficiency is no longer a requirement.

This also means we can individually tune each stage, rather than the original gang tuning and make any other adjustments to peak up the output. Using a plate supply voltage of only 400, a power output of 22 watts can be achieved with all stages running practically



Rear panel view of Collins ARC-27 power amplifier assembly. Input stage at right and input coax shown. Output coax is at the left in the photo. A Jones plug at right also accepts the heater and plate voltage for the unit.



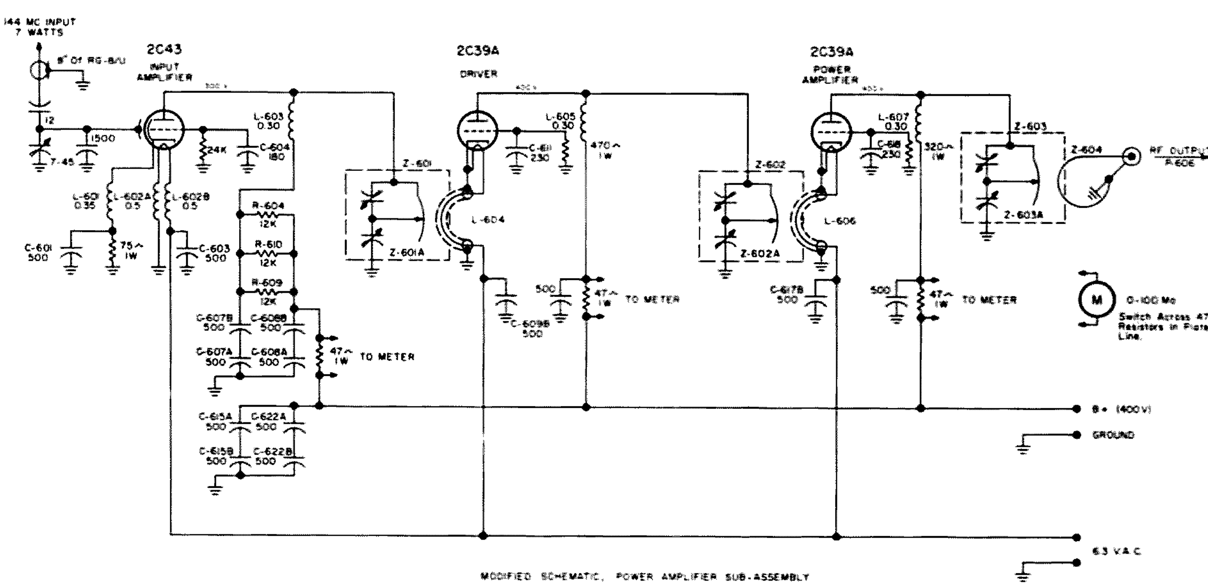
ORIGINAL SCHEMATIC BEFORE MODIFICATION

stone cold. Since the 2C39A tube is rated at a maximum plate voltage of around 1,000 volts and has a plate dissipation of 100 watts, we can then run the tubes in amateur fashion and it is not too much of a trick to obtain an output of as much as 50 or so watts, if one needs this much output power to drive the final stage.

At this station (W5AJG) we have pegged our unit at 40 watts input to the final 2C39A with a measured output of 22 watts. Under these rather lightly loaded conditions, the tubes have never been changed in many months' operation. This unit drives a couple of 4X150A's in push-pull for the final amplifier (modified surplus T-217A). Since the power limitation has been 50 watts input, this final has never been pushed to any extent, but since high-power is now legal on this band, the ARC-27 exciter is capable of driving this amplifier to at least 400 watts input, and perhaps more.

The modifications necessary to extend the already mentioned frequency upper limit of 399.9 mc to the desired 432 mc, and convert the input 2C43 tube to a slightly different function, are of minor nature and very little or no trouble should be encountered in this change.

First off—an UHF grid dip meter is just as valuable at 432 mc as at the HF's. Probably more so. If you do not have one, it is strongly recommended that you now acquire, borrow or build one. It will save a lot of grief in your 432 pranking and speed up your construction work immeasurably. Several of these ARC-27 rf decks are now in operation down in this territory and what little trouble was experienced in getting them going was directly due



MODIFIED SCHEMATIC, POWER AMPLIFIER SUB-ASSEMBLY

to the participants not having a GDO that will cover these frequencies.

Of course if you insist on not having an UHF GDO, this will not stop you from putting the unit on frequency, but it is a genuine pleasure to be able to fire up a modified unit and have it hit 432 mc in all its tanks, instead of 288 mc or some other odd multiple of which we are definitely not wanting any, thank you.

Modifications

To get started then, refer to the original circuit of this subassembly and compare it with the modified circuit. It can be seen right off that the heater voltage for the tubes is changed from the ARC-27 way to the more conventional 6.3vac ham way. Next, the bottom end of the cathode input tanks, L-604 and L-606 are grounded with as short a strap of copper material as is possible and as direct to the chassis as is possible. Do a good job here. After these changes, the heaters will receive the proper voltages.

The three tube output tank circuits will be tackled next. These ingenious devices are known as Hubbard tanks, and due to their construction, a very wide frequency range is possible. These are the units we wish to extend to 432 mc from their previous top limit of 399.9 mc. Now, altho all these units look like two peas in a pod, it appears that when attempts are made to extend their frequency, some units respond better than others. This is where the GDO is worth its weight in gold. You simply can not tell just by looking. If your unit does not reach as high as 432 mc, it will be necessary to operate on the several sectors of the rotor of the tuning capacitors. These sectors of the rotor can be bent back, or entirely removed until such a time as the GDO indicates that you have reached 432 mc. Some units will require bending, some complete elimination of several sectors and some no change at all. The trimmer capacitors associated with these three transmitting tanks consists of a brass slug adjustable towards a cup to increase capacitance and away from the cup to decrease it. These are really temperature compensating capacitors and range from 1.5 to 2.5 mmfd in value. They were meant to operate in such a way as to physically compensate for any changes brought about by temperature variations, reducing tuner detuning considerably. In an aircraft, these units were completely bottled up and were operated at different altitudes and temperatures. As used in our work and with a blower on the tubes, no detuning is detectable and these particular compensating capacitors are not even

necessary. They may even be removed if you wish. Just make the tanks resonate on 432 mc with the GDO and there will be no sweat.

With the heaters of the tubes taken care of as well as having the tanks on frequency, the remainder of the modifications are simple and will be described stage by stage in turn.

2C43 Input Stage

This is a grounded grid, cathode driven input stage using a 2C43 type tube. We must now make a decision as to what frequency we will drive into the tube. It will be very flexible and you can go any route that will best fit your particular requirements. They will all work very well.

Most will desire to use the 2C43 stage as a tripler from 144 mc. However, some will elect to use the tube as a doubler from 216 mc, and a few will probably choose to use the stage as a straight through amplifier on 432 mc. This latter arrangement is perfectly sound if one already has a few watts of 432 mc energy available and wishes to use it.

Since the plate tank of this input tube is always at 432 mc, then it will merely become a choice as to its input and the only thing one will have to do is to select the proper size of rf chokes to be used in the heaters and cathode of the 2C43 tube. Actually, the rf chokes as originally installed are designed to range the frequency of from 225 mc to 399.9 mc and will work very well as is. As the original diagram shows, these are values of from .35 to .50 μh windings. Very often though, these Collins rf decks as picked up from the bare ground at various junkyards are minus the 2C43 socket which will contain certain components, including the rf chokes. (We refer here to the octal socket.)

In such a case, it is suggested that rf chokes of the desired driving input frequency be used. For example, if one desires to make a tripler of the first stage, then chokes of the Ohmite Z-144 type (1.8 μh) should be used. Should the stage be employed as a doubler from 216 mc, then type Z-235 (.84 μh) should be used, and finally if the stage is to be used as a straight through 432 mc amplifier, then Z-460 types (.2 μh) would be used.

For tripling service a new cathode resistor of 75 ohms is substituted for the original 47 ohm value. This was found to work well in tripling service. A new grid leak resistor of 24K is substituted for the original 2.2K. This also helps the tripling efficiency. The plate dropping resistors should work as is and the final desired voltage at the plate of the 2C43 tripler should be 300 volts. This will result in 18 to 25 mils of plate current. Grid current derived from the 144 mc drive to the tube should show at least 2.8 ma or more. Grid voltage as measured with the unit fully operational was found to be around 67 volts dc. Cathode voltage checked 1.4 v. If desired, a 47 ohm, 1 watt resistor may be inserted in the +B line to this stage and a meter switched across it to measure plate current.

A word about the input matching. The modified circuit shown assumes tripler operation from 144 mc. A driver with 7 watts output is used here. One of 5 watts will probably get by, if the coupling circuit efficiency is good, but at least 7 watts should be available for a bit of reserve with aging tubes. With the coupling coax (RG-8/U) about 8 inches in length, the arrangement as shown of capacitor matching works very well. Should the length of coax be something very much different from this value, it is possible that experimentation with the value of the 1500 mmfd capacitor would be advisable. Merely adjust for maximum rectified grid current in the 2C43 grid circuit.

2C39A Driver Stage

Changes on this stage consist of eliminating R605, R606, R613, C609A and C612. A new grid leak resistor of 470 ohms is substituted for the original one of 7.5K. Another 47 ohm resistor may be inserted in the B lead to measure plate current. A 500 mmfd by-pass should be used on the top side of this sampling resistor.

The values that should be encountered on this stage would be about 45 ma plate current–grid current of about 5.5 ma at the minimum and a developed grid voltage of about 2.6 vdc. That's all.

2C39A Final Power Amplifier Stage

Eliminate R608, R611, R614, R612 and C617A and C619. A new value grid leak resistor of 320 ohms, 1 watt, should be placed across the capacitor C-618. This stage may also employ a 47 ohm, 1 watt, sampling resistor in its B lead to measure plate current. An 0-100 ma meter may be shunted across any of the three stages to read plate current.

This stage should show about 100 ma of plate current when loaded and with a supply voltage of 400vdc. The grid current will measure about 37.5 ma and a developed grid voltage of about 12 volts should be observed.

This will represent a dc input to this stage of 40 watts and with a commercial 52 ohm watt meter good to 1,000 mc, 22 watts was indicated. By increasing the plate voltage on the final 2C39 and juggling the grid resistor

a bit, an output of 50 watts is easily achieved, although the tube life under this type operation is not known. Under the 22 watt output type operation, the tubes should last practically forever. At least they have been operating over two years at this time and no changes have been necessary or made.

Air is required on the tubes and some sort of a small blower system is necessary. The photo shows one way of doing it by mounting the blowers on the front panel and blowing thru two panel opening. Any other scheme will be OK. Suit yourself.

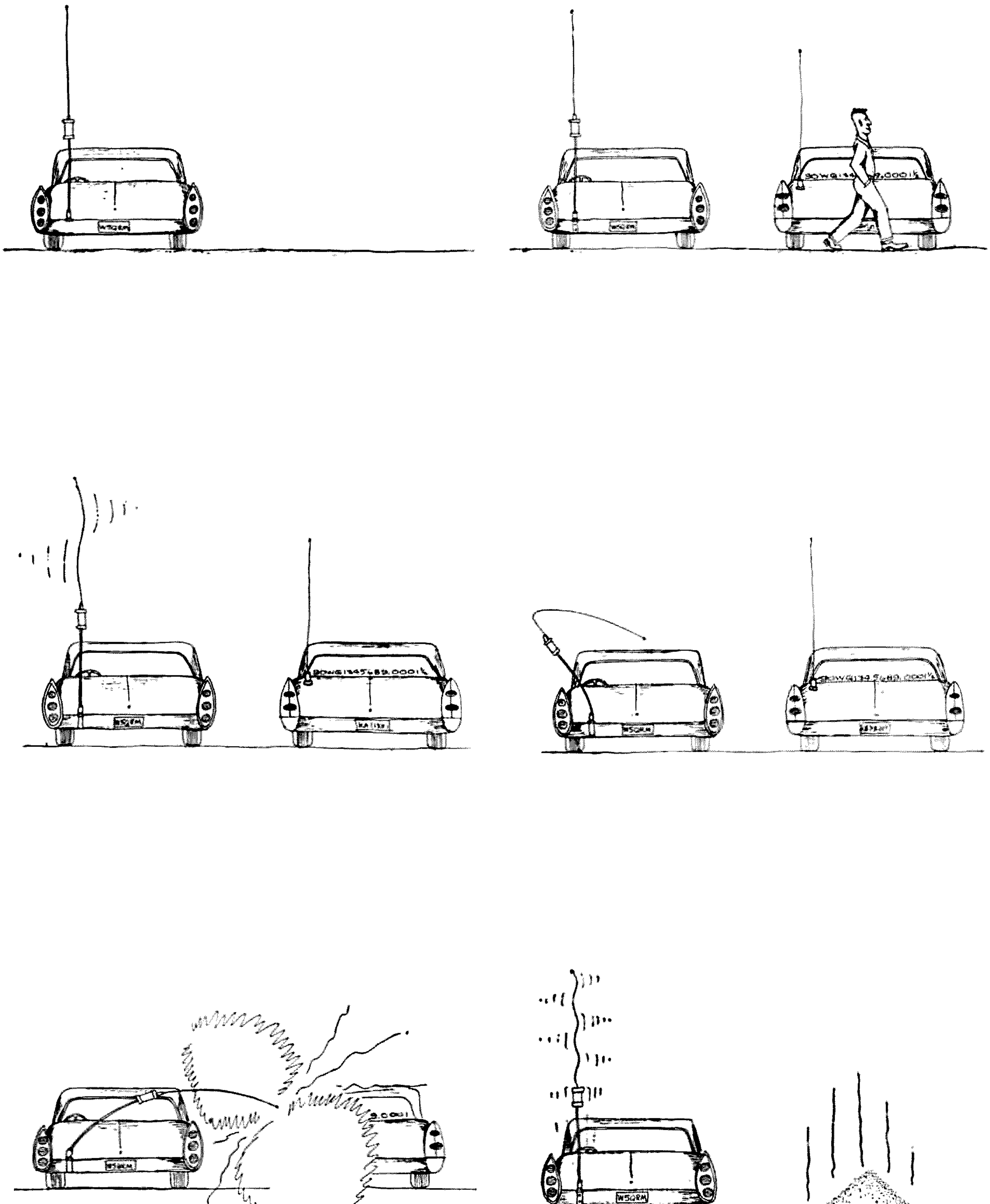
Several stations around this area are now using this converted ARC-27 unit including W5SWV, W5NU, W5HPT, K5JHG and W5AJG. All stations report smooth operation.

Of course, these units will cross 220 mc also and if used for this frequency, no changes should be necessary on the Hubbard tanks. However, unless one is fortunate enough to possess more than one of these units, it seems a bit of a sacrilege to use such a gizmo on 220 mc, when its main worth would be for 432 mc operation.

So use it on 432 preferably—220 mc if you must, but in any event, watch that undesired 288 mc output (second harmonic of 144 mc drive). It is still hot as a pistol on this frequency and can get you in trouble if you are not watchful. Use the GDO, or lacking that, the absorption wave meter to be sure each stage is on the right 432 mc frequency.

. . . W5AJG

de W5IMJ



Staff

Sideband Linears

One of the first items mentioned, when anyone talks about sideband, is a "linear." You probably already have figured out that he's referring to a "linear amplifier"—but you may not know why it's so important.

As mentioned earlier in this series, sideband is different than AM. The biggest difference is that sideband consists of the *actual* voice waveform, transposed to a frequency up in the rf region.

And since it *is* an exact replica of the voice waveform, obviously any amplifier used to boost the power fed to the antenna must do its amplifying without distorting the signal in any way.

And really, that's all a "linear" is—an amplifier which amplifies without distorting.

The name "linear" is a bit of engineeringese which has crept into the ham vocabulary; it refers, originally, to the graph of input voltage versus output voltage of the amplifier. Fig. 1 shows a typical example. So long as this graph is a straight *line*, the response is said to be *linear;* when it begins to curve for any reason so that output is no longer exactly like input only more so, it is called non-linear.

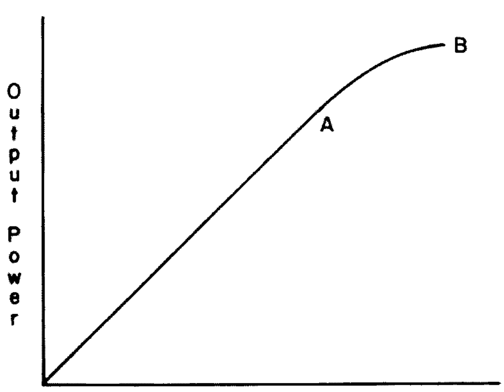


FIGURE 1

Typical linearity graph

The amplifier whose graph is shown in Fig. 1's linear up to point A; from this point on, it is non-linear.

This illustrates very neatly the fact that any "linear" amplifier is that only up to a point; trying to get more out of it, once you reach that point, only gets you trouble instead. But more on that later, in its proper place.

Now that we've established *why* is a linear and, by implication, *what* is a linear, let's take a little closer look at exactly what a linear is.

We already said that a linear is any amplifier which does not distort. We all use them every day; any audio amplifier has to be pretty linear for us to tolerate it. In addition, the rf and *if* stages of your receiver are also linears —at least, up to the overload point. And if you want to find out firsthand what an overloaded linear sounds like, then switch your avc to "manual", turn the rf gain wide open, and tune to one of the "60-over-9" local signals. The resulting mess coming out of the speaker will etch the difference between a good linear and a non-linear "linear" (or an overloaded one) permanently into your brain!

But what, you may ask, does a linear's circuit look like?

The answer is that it *can* look like any other rf amplifier circuit; the secret of linear operation is in the specific voltages you apply to the tube rather than in the circuit arrangement. There are a few exceptions to this rule, and we'll look at them a little later, but it holds true most of the time.

We already mentioned audio and receiver rf-*if* amplifiers as typical linear amplifiers; these are, for the most part, class A circuits.

Much confusion has been generated by the letter classification of circuit operating condi-

tions; we'll define "class A" for this series as being that set of conditions in which plate current flows at all times. This is the easiest set of conditions to operate under, but also is the least efficient.

For instance, typical efficiency of a class A circuit is about 25 percent. That means for 10 watts in, you'll get about 2½ watts out.

At power levels below about 3 watts out, this is usually of little consequence. As a result most sideband *driver* amplifier stages (those operating at low power levels) use a class A circuit.. But when it comes to putting 400 watts in to get only 100 out—or having to settle for 250 watts into the antenna at the legal limit!—the class A configuration usually goes by the boards.

Next step up the efficiency ladder is the class B circuit; for our purposes, this is one in which plate flows *exactly* half the time.

Theoretical efficiency of a class B amplifier is 78½ percent; in practice, you can expect about 60 percent.

In audio use, a class B amplifier requires two tubes and they must be connected in push-pull. This is so because the class B circuit amplifies only one-half of each cycle of incoming signal.

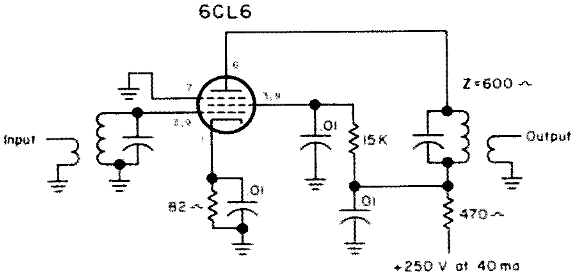
However, at rf, a single tube may be used; alternately, two tubes can be run in parallel. This is possible because the input and output tank circuits act as flywheels and supply the missing half-cycles; no one ever knows the difference.

Since the class B circuit is a little more complicated than the class A (it requires some driving power), it is seldom used where a class A circuit can be used in its place. When you need more than about 3 watts output, though, it can be and has been used well. Tubes are available which will take up to the legal limit (and more) in class B service.

But we said a little earlier that true class B means plate current flows exactly half the time. With most available tubes (we know of no exceptions, but hesitate to make a flat statement), operation in true class B produces excessive distortion of a most unpleasant kind.

In audio, it's called "crossover distortion" and no more descriptive name could be found; it's caused by the tube's cutting on and off every half-cycle.

The effect can be minimized by allowing *some* plate current to flow even when the tube is producing no output. This is a cross between classes A and B, and is known as class AB operation.



Pins 4 And 5 Are Heaters

FIGURE 2

Class A 4 watt linear

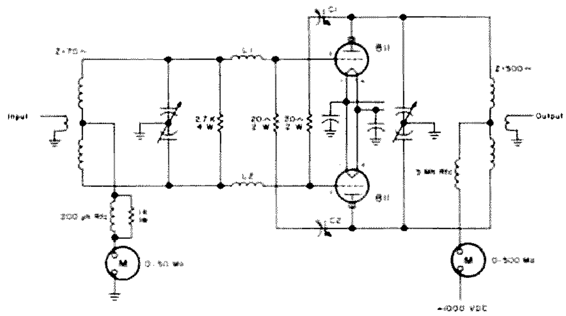


FIGURE 3

Class B linear using 811's
L1, L2, — 9 turns #12, 1½" dia., 1¼" long
C1, C2, — Bud type NC-853 neutralizing capacitors

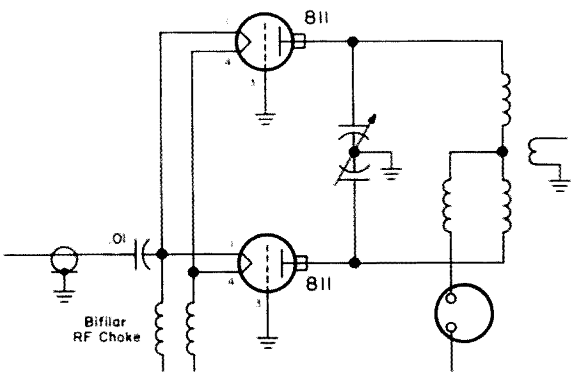


FIGURE 4

811 G-G class B linear, all plate components same as Fig. 3

Class AB operation is the most common kind; it is further subdivided into two subclasses: AB1 and AB2. In AB1, as in class A, the control grid never draws any current. This means that no driving power is required, and consequently the driver stage need not be so bulky.

In AB2, as in class B, grid current flows on positive peaks of incoming signal but not on negative peaks. This means that some driving power is required, and also means that the driver stage will see a load that varies during the cycle from a relatively high value to almost nothing al all.

Efficiencies of AB1 and AB2 both compare to those of class B. Exact figures depend on too many variables to be quoted, but in practice the 60 percent won't be far off. Like class B, these may run up to and beyond the legal limit.

But there's still another class of amplifiers, class C. What about this one?

Most people will tell you offhand that a class C amplifier cannot be linear. However, quite a few "class C linears" have been built and used by people who refused to believe what they heard.

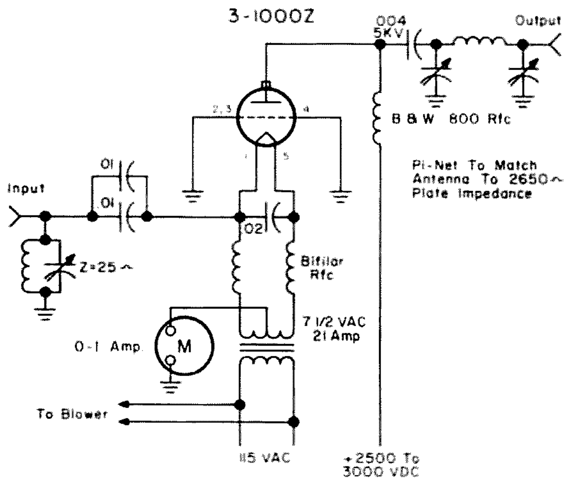


FIGURE 5

3-1000Z 2 KW PEP linear

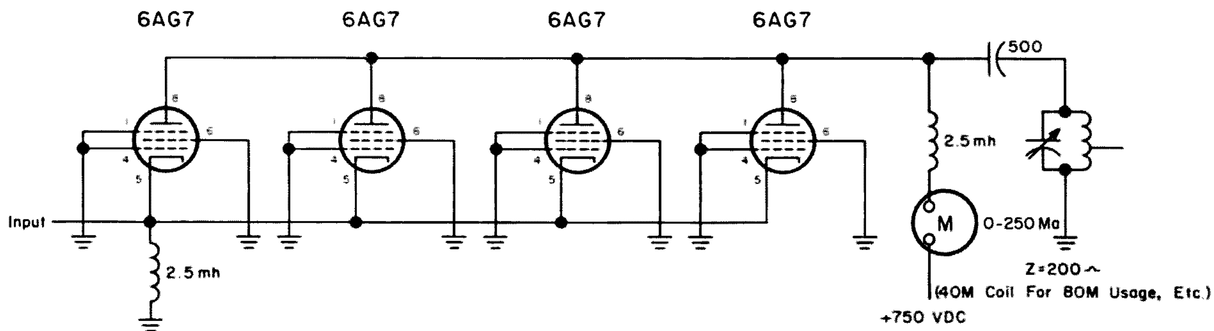


FIGURE 6
Cheap and simple linear with four 6AG7's

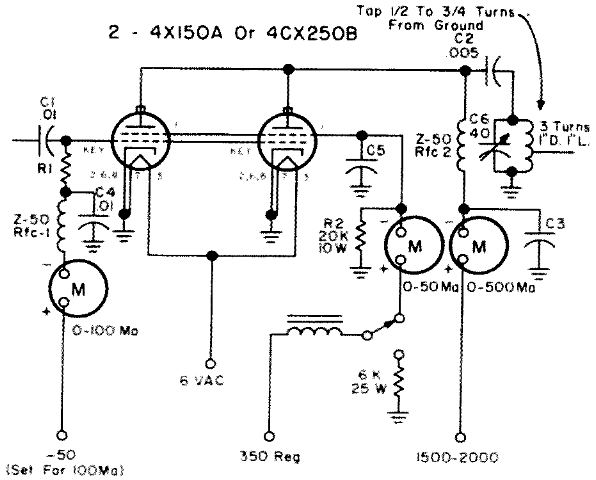


FIGURE 7

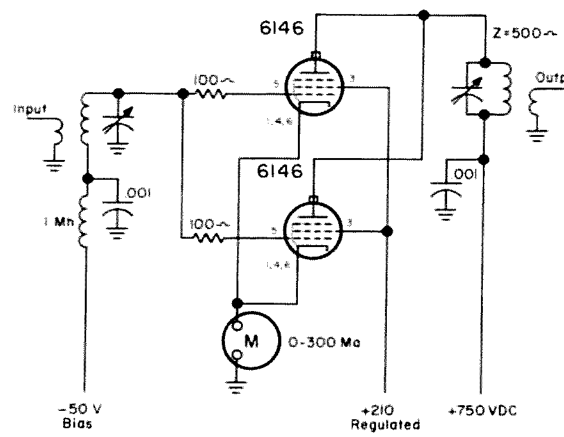


FIGURE 8
Dual 6146 linear capable of 120 watts

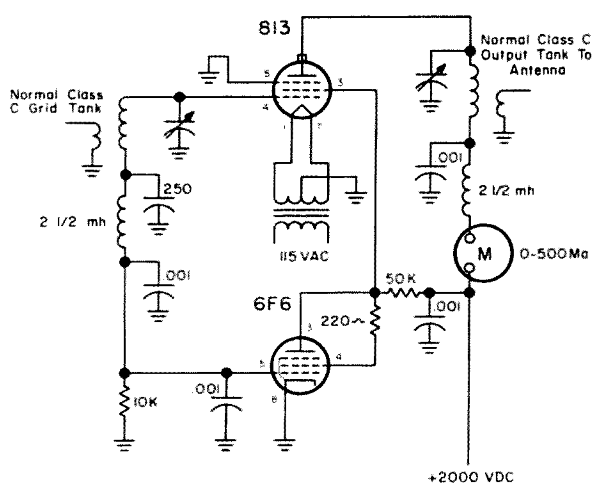


FIGURE 9

PEP output ZL linear using 813; 6L6 will sub for 6F6

This type of amplifier is an exception to the rule cited earlier that linearity does not depend on the circuit. It's also known as the "ZL linear" and the circuit is the key to its success. We'll look at it in detail when we get to that stage in typical circuits.

Speaking of typical circuits, let's look at a few, in the same order we went through the classes.

Fig. 2 shows a typical class A linear. Note that tank circuit values are not given in C and L but are, instead, in ohms of reactance. This allows you to use this circuit at any frequency by simply figuring out how much C provides this many ohms and dipping the coil to resonate with the resulting C value.

This class A linear uses a type 6CL6 tube, and is good for up to about 4 watts output with the voltages listed. For lower power use, take the typical receiver *if* schematic from any issue of the ARRL manual and use it with 6BA6 or similar tubes.

A typical class B linear using a pair of 811's and capable of giving peak-power outputs up to 400 watts is shown in Fig. 3. It requires about 10 watts of drive for maximum output, and so cannot simply be tied on behind the 4-watt unit of Fig. 2.

Note that cross-neutralization is employed in the circuit of Fig. 3. Since 811's and similar zero-bias tubes offer many advantages for sideband, experimenters looked around for a good way to avoid the need for neutralization. They came up with the grounded-grid circuit, shown in Fig. 4.

Output of this circuit is essentially the same as that of the circuit of Fig. 3, but drive requirements are now in the neighborhood of 50 watts. Most of this power is fed straight through the amplifier to appear in the output, however.

As more and more medium-power commercial exciters came on the market, the power-gulping qualities of the g-g circuit became more popular, until specially designed grounded-grid tubes such as the 3-400Z, 3-1000Z, and PL-6569 were made available. Any of these tubes may be driven to the legal limit by 65 watts or less from the exciter. A circuit suitable for use with a 3-1000Z is shown in Fig. 5.

One of the more popular circuits before the high-power rush appeared—and one still popular among the QRP gang—used four type 6AG7's in grounded-grid. It was simple, inexpensive, and could really perform. First described by W6GEG some years ago, it has been expounded upon at length by Ed Marriner. The circuit appears in Fig. 6; with 6AG7's, this will give 150 watts PEP which is a highly respectable signal.

Going back to the class B (conventional) circuit of Fig. 3, you'll note the swamping resistor across the grid tank. This is necessary

to make the driver stage see approximately the same load at all times. The grounded-grid versions, because of their extraordinarily low input impedance, requiring no swamping.

Another way, of course, to eliminate the problems of swamping is to operate class AB1. Almost all class AB1 linears use beam power tubes since they are capable of large output power with little drive.

A typical circuit using the 4X250B appears in Fig. 7. With proper tank circuits, this circuit is usable to 500 mc (provided the right impedance values appear at the plate and the output).

A less exotic version, still good to about 60 mc with 120 watts PEP, is the double-6146 rig shown schematically in Fig. 8. This is typical of possibly the majority of today's medium-power linear circuits, with some variation of voltages.

In all AB1 linears, it's best to adjust the bias voltage so that the tubes are running at about 1/3 of their total rated dissipation with no input signal applied. These values are indicated on Fig. 7 and 8. Then, after tuning up and running a linearity check, it can be adjusted slightly for best possible linearity.

A spell back there, we promised a detailed look at the ZL linear. The circuit is shown in Fig. 9; in operation, this is a sort of "screen-moduated" linear. The 813 is operated class C. However, the amount of screen voltage it has to work with from instant to instant is determined by the amplitude of the incoming signal, and with proper adjustment this "screen-modulation" process can be made to reproduce the output signal as an exact replica of the input, only bigger. And that, by definition, is a linear!

The 6L6 is more of a clamp-tube modulator in this circuit than it is anything else; linearity of the circuit is determined primarily by the linearity of the 6L6. With parts values as specified, it should work nicely. Experimentation with voltages or values is at your own risk!

This about rounds up the subject of linears as well as it even can be in the pages of a single magazine issue. To be complete, we would have to show circuits using every different type of transmitting tube in every possible configuration—and this would run to hundreds of pages! Just remember that it's the operating conditions, rather than the circuit, which make a linear work right, and you'll have no trouble.

We haven't touched much on designing your own linear; that's almost a book in itself, and a number of excellent articles on the subject are already in print. Several of them are listed in the references below.

And the tuneup procedure, which has been known to scare many potential sidebanders? That's part of the subject of the next installment!

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Barney and the ZDO

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There's something about DX-mania that makes a man mean.

I've seen friends of thirty years pass each other on the street without a word, because of some DX-rivalry. I've seen a big, amiable guy turn childish and petty and spiteful if he can thereby get that rare QSL. I've see decent citizens stoop to all kinds of chicanery to put one over on the rest of the gang and rational, sensible, kindly Dr. Jekyll's turn into ruthless,

hysterical Mr. Hyde's at the mention of a long-sought call. What they can see in it all beats me. The contact is brief and brutal—exchange of reports, through that insane QRM, and it's the turn of the next sheep after a sheepskin.

In our town we do go after the DX occasionally, just for kicks, but we try not to lose our sense of proportion over it. And we always hunt in a pack, for we know that it's useless expending all that power QRM'ing each other—rather work together and achieve something—if, indeed, it's even worth the fight. If there's something rare in the offing, then we call each other up on the landline, no matter what time of night or day, and we share the spoils, so to speak. That's where poor Barney went wrong when he kept the PK4 to himself.

It all began when the old Billiter place, which had been up for sale ever since any of us could remember, suddenly swarmed with builders, landscape gardeners and interior decorators. Obviously there was big money at work, for the fine old house on the hill soon bloomed again under their ministrations. Then one day I got an urgent call at my office from Bob, our local Police Chief, whose own house had a clear view of the hill. "Bill," he said, excitedly, "take a look out of your south-west window and tell me if you can see what I can see."

When a cop tells you to take a look you take a look, even if he is a life-long friend and first-class operator. There, blossoming in all its dollar-laden glory, soared the biggest and lushest antenna array I had ever seen. It was one of *us* who had arrived in town.

Barney soon made himself known at our Radio Club and a nicer guy you couldn't hope to meet. He had retired from business, and very nicely too, if the way he had refurbished and refurnished the old house was any yardstick. His wife was up to standard, too. Several years younger than her adoring spouse, Evelina was a DISH, if you like your dishes empty. Her clothes came from Paris, her shoes from Rome; her furs looked better on her than they did on the original chinchillas; her diamonds came from THAT store in New York. We guys just used to bask in the glory of those huge blue orbs and have quite surprising dreams about the long, silver-blonde hair, which she drove thirty miles twice weekly into the city to have dressed into yet more perfect elegance. Dream was all we did, though, for Barney was a very big man and worshipped his Evelina. She accepted his adoration and our homage in a kind of dreamy daze and with almost complete silence. Evelina rarely spoke and if she did it was to let such precious

pearls drop from those sculptured lips as:—
"Kinda hot today."
or
"Cream or sugar?"

A perfect woman.

Barney was very wealthy indeed, yet you couldn't find a more kindly or generous man anywhere in the Callbook. I was proud to call him my friend—up to a point!

For Barney had that terrible blind spot—DX-mania. Mention a rare call that was due on the air and the bluff face would go sort of tight and quiet, the clear eyes cloud with secrecy and deception. Not that he wouldn't share the goodies life had brought him. When one of the Radio Club had some financial bad luck, it was Barney who made up the deficit out of his own pocket. Barney helped to equip a disabled local radio amateur. When we wanted to establish a yearly scholarship to send high school kids to college to study electronics, Barney headed the subscription list.

But let it be known on the tomtoms that a KP6 was due, or that there was a chance of a HKØ, and it was every man for himself. With his superb commercial gear, hilltop QTH and that dreamy antenna, Barney was more man than any of us.

To Barney, the lovely Evelina was the sun and the moon. But his stars were his DX-score, which he toted up zealously at each addition and jealously compared with top operators all over the world.

It was the PK4 that did it. Nobody except Barney knew there was to be a station on Sumatra until Barney had worked him and the station had departed.

Every Thursday night we would meet at Barney's for a regular ragchew. This took place in the palatial basement, with its air conditioning and wall-to-wall carpeting, which he democratically called a "shack." Beer flowed with Barney's customary lavishness and the air became thick with the smoke of his cigars. Then he casually displayed the brilliantly coloured QSL, with the strip of exotic stamps proclaiming without doubt its horrid authenticity.

"Gee, fellers," boomed Barney, in his most regular-guy manner, "I'm that peeved I didn't call you up and tell you he was on. I just guessed you would have known all about it!"

Not that we really cared about the PK4. It was just the tricky way he had fooled us that set the fuse.

One thing Barney had never worked was a ZDØ. From time to time rumour had it that an expedition was to go to Claney Island, but the remote and unhospitable rocky islet in the South Atlantic, whose terrain and climate made even Tristan look inviting, did little to attract those intrepid adventurers whose whole existence seems to be devoted to letting a little sunshine into the lives of stop-at-home DX-fiends. The call ZDØ was a DX joke, a sort of DX Eldorado, the pot of gold at the end of the rainbow, fourteen hundred miles south of St. Helena.

So when the news came that a Scotsman, on a world anthropological survey, was to spend a few hours on Claney, just between tides, and that the blessed Scotsman was also a radio amateur, the DX world was in ferment. ZDØAA was to be in business.

Those tough, remorseless, hard-eyed babes, to whom amateur radio was now reduced to months of mere listening, without saying one word, waiting to pounce the moment the sought-after call came through, were girding up their loins—and their linears.

Was it my fault that my own dear and faithful wife, Janet, had persuaded Evelina to try a new hairdresser in the city that day? Or that Janet had managed to drum it into the exquisite vacuum that served Evelina for a head to keep the venture a dead secret from Barney, so that his delight in her enhanced tresses should be even greater because of the big surprise?

The girls left early that morning for the city in Evelina's snazzy new Italian roadster. The maid served Barney's lunch, but he was so busy checking and testing his rig all day that it wasn't until early evening that he noticed that the loveliest ornament in his establishment was missing. Even then he wasn't too worried. Evelina loved to shop. Indeed most of her extensive spare time was spent in searching for even more items to add to her fabulous wardrobe, or more gew-gaws for the house on the hill. Evelina would soon be home, burbling over some pricey new acquisition, like a child with a new toy.

When the girls came out of the coiffeur's sumptuous salon, it was evening and raining heavily. Imagine their distress when no amount of coaxing would persuade Evelina's car to start. They were stranded in the big city. Janet swore afterwards that she tried and tried to rent a car and to call Barney, to save Evelina from unnatural mental effort. She called me and I tried to call Barney, but he had taken the phone from the hook, a thing he would do to ensure unbroken peace when something important was on the air.

Evelina and Janet were comfortably settled in a hotel in the city when Barney really began

to worry. He questioned the servants and called the Country Club, where she might have dropped in for a cocktail and been stranded by the downpour. Then he called Bob, in his official capacity. The Chief of Police promised to keep a sharp lookout for a tiny, low-slung Italian drop-head and to let Barney know the moment news came in, whether it be good or . . . . the frantic Barney slammed down the phone and rushed out to his own big sedan. Bob went straight back to his own rig to work the ZDØ, who was due to come up any minute. Bob had been one of those who had missed the PK4.

Barney spent most of that night looking for the wandering Evelina, searching the black, wet countryside, with heaven knows what dire thoughts of younger men, even wealthier men, men who could offer her more furs, diamonds and European cars than he could. Meanwhile the precious few hours of the ZDØ sifted away.

Next morning Evelina returned in the revived roadster, a very lovely strawberry blonde Evelina, with lavender highlights. It was never quite decided just what it was that had troubled the Italian car. Of course, the garage where Evelina always parks it on her ritual visits to the City, is owned by a cousin of Fred, who was another of those who didn't work the PK4.

Many years will elapse before anyone as tough as the anthropological Scotsman braves the terrors of Claney Island to put ZDØ on the map once more. The card is quite simple, but obviously authentic. It seems a shame that a big, lovable guy like Barney should have missed such a momentous QSO and not be able to add yet another rare call to his list.

But, as I said before, DX-mania makes men very mean, very mean indeed.

Antenna Fact and Fiction

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The explosive increase in ham-band occupancy has brought tremendous changes to our hobby during the past 15 years. One of the most obvious is the availability and use of directive, rotable "beam" antennas. Nowadays the latest in commercial beams is within the reach of almost everyone's modern credit plan. Unfortunately, it is not easy to precisely determine (either by calculation or by measurement) the performance parameters of an antenna, even in the (unusual) case where installation and/or environmental factors can be closely controlled. Because meaningful direct measurements and relative comparisons are beyond the means of most hams, and because of the competitive nature of the business, claims of many authors and advertisers have traditionally tended toward the overly optimistic.

For the ham desiring a better feel for what transpires twixt his transmitter output and somebody else's receiver input, several detailed but reasonably elementary references are available.[1, 2] A passing acquaintance with geometry and trig opens further horizons in classical antenna theory and practice.[3, 4] Even if you refuse to run down to the local ham emporium for fresh reading matter, there is hope. This article is an attempt to suggest the reasonable approach to thinking for yourself in distinguishing antenna fact from antenna fiction.

What do we look for in articles or ads featuring antennas? The list probably goes something like this:

1. Price (Alternatively, cost and effort to build)
2. Gain
3. SWR (standing wave ratio)
4. Front-to-back ratio (also front-to-side ratio)
5. Bandwidth
6. Size and weight

The order of priority varies with the individual, but all of these items are significant. Some of

us (apparently) are also swayed by recitations of DX worked with the new antenna, usually in a short period of time with 150 watts or less.

Price

The *price* factor is pretty much beyond the scope of this article, except to note that the price you pay is generally reflected fairly well in the physical construction of the antenna. If physical strength is not too much of a factor in your location, price is not a very good indication of the "best" array for you.

Gain

Gain, generally speaking, is the ratio of power density radiated by the antenna in its most favored direction to power density radiated by a specified reference antenna in its most favored direction. Two types of reference antennas are in common use—the half-wave dipole and the more esoteric *isotropic* radiator. The latter is a hypothetical device which radiates uniformly in *all* directions, three-dimensionally. Because of the dipole's mildly directive pattern, it exhibits a little over 2 db gain, referred to the isotropic radiator. Antenna gain figures have significance *only when the reference antenna type is explicitly stated.*

Practical high frequency antennas for amateur use must ordinarily operate within a very few wavelengths (at most) of ground. This nearby reflective surface drastically influences every antenna's vertical radiation pattern. Consequently, the most favored direction must be described not only as forward, but also in terms of the vertical angle of the main lobe. The influence of nearby ground on antenna gain, vertical pattern, and feed-point impedance is discussed at length in the references. It is sufficient here to point out that one antenna may in practice show *apparent gain* over another simply because the elevation of its main lobe happens to correspond more closely to the optimum vertical radiation angle for the particular path and propagation conditions existing at the time.

A confusion factor introduced by current receiver design practice is the *S-Meter Decibel,* or *SMDB.* Over the years since Hertz and Marconi, it has become popular to express power ratios by finding their common logarithm (yielding the ratio expressed in *bels*) and multiplying by 10 to get *decibels.* Recently, receiver designers have found it unnecessarily restrictive to calibrate S-meters in terms of conventional S-units of 6 old-fashioned decibels (db). The exact definition of the new S-unit is something of an enigma. Consequently, only data taken with laboratory test equipment, or with a receiver calibrated by laboratory methods, can be relied on to indicate the true pattern of an antenna. This is one of the biggest reasons why authors' claims for home-brew antennas must usually be taken with a large grain of salt.

Standing Wave Ratio

The subject of standing wave ratio (SWR) has been widely treated in ham literature, yet many gross misunderstandings persist. Simply stated, SWR is the ratio of impedance mismatch between antenna and feedline. Since the feed-point impedance of any antenna varies considerably with height above ground and distance from surrounding objects, near-unity (1:1) SWR can ordinarily be achieved only by the use of an adjustable matching device. It is unrealistic to *expect* better than about 1.5:1 SWR from any antenna, beam or otherwise, unless it is at least a wavelength clear of all objects or is matched while in position. As others have pointed out, though, an SWR of 1.5:1 is of little consequence insofar as line losses are concerned.[a] At 28 mc 100 feet of fresh RG-8/U coax will introduce about 1 db loss when perfectly matched to the load (1:1 SWR). The existence of a 1.5:1 SWR causes only about 0.02 db additional loss. As a matter of fact, an SWR of about 13:1 is required to double the 1 db loss inherent in a perfectly-matched line! On the other hand, high SWR presents difficulties with respect to transmitter loading and the use of a low-pass filter. Also, a system operating with high SWR on the transmission line is usually more frequency-sensitive than a well-matched one. The most important thing to remember is that trimming the feeder or using an antenna tuner at the transmitter changes only the *apparent* SWR (actually, the live input impedance) seen by the transmitter. The *actual* SWR on the line, and hence line losses and system frequency-sensitivity, can be changed *only* by varying the match at the antenna.

Estimating the Probable Performance of Arrays

Although it is sometimes difficult to accurately evaluate the validity of performance claims, a respectable estimate can often be achieved by combining some knowledge of basic radiating elements with a bit of insight into the effect of array configuration. A most useful principle to remember is that of *pattern multiplication,* which may be stated thus: the overall pattern of an array of elements is determined by multiplying (the pattern of a

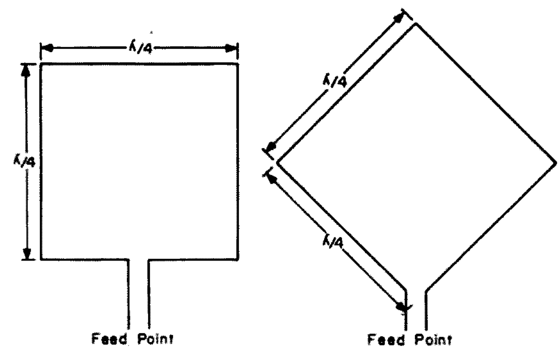
[a] See Ref. (1), pp. 77, 84, 85.

single element of the basic type used) X (the pattern of a similarly spaced and phased array using isotropic radiating elements). Also, the principle of reciprocity states in effect that the transmitting and receiving patterns of an antenna are identical. If a voltage applied to antenna A produces a current in antenna B, then the same voltage applied to B will produce the same current in A. This principle of reciprocity applies *only* if the medium connecting the two antennas is linear and bilateral—that is, if propagation characteristics of the connecting path are identical in either direction. This is often not the case with ionospheric skip.

Aside from the composite array's radiation pattern in the horizontal plane, its SWR, and its bandwidth, some thought must be given to the implications of polarization and propagation phenomena, the antenna environment (height and surrounding objects), and so forth. Finally, one should recognize that "DX worked" recitations are significant only when the antenna in question is compared directly, on a contact-by-contact basis, with a reference antenna whose characteristics are well-known. Even the most casual ham should realize that band conditions vary greatly with time, that spectacular results frequently can be achieved with low power and simple antennas, and that SMDB's cannot be relied upon. Even contest results have little significance without details as to operator and equipment, quantity, quality and dedication of the competition, and propagation conditions.

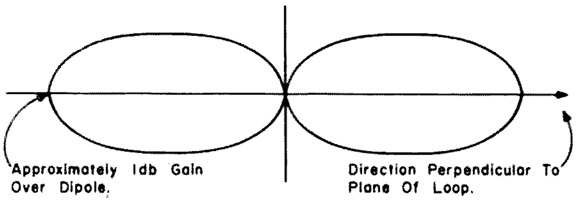
The majority of antenna interest and advertising in amateur publications today is related to three varieties of *parasitic* array—the conventional parasitic beam or yagi, the cubical quad, and the "dual diversity" array recently described in 73.[6] A wide variety of *driven* arrays (i.e., those whose elements are all excited directly by physical connection to a feed system) are described in the references, and are capable of giving good results without undue complexity. None of these has approached the popularity of the rotable parasitic array for amateur usage however, probably because the latter offers somewhat better (unidirectional) gain per square foot of sky. Two simple driven arrays are nevertheless of substantial current interest, due to their use as elements of the parasitic arrays mentioned above.

The one-wavelength square loop, used as the basic element of the cubical quad, is shown in Fig. 1a. It is convenient to think of this as two half-wave dipoles, spaced vertically by



ONE-WAVELENGTH SQUARE LOOP

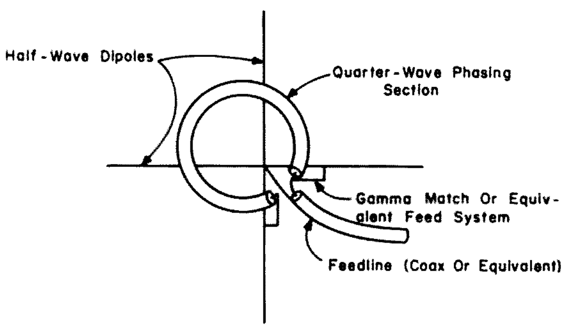
FIGURE 1A



HORIZONTAL PATTERN
One Wavelength Square Loop

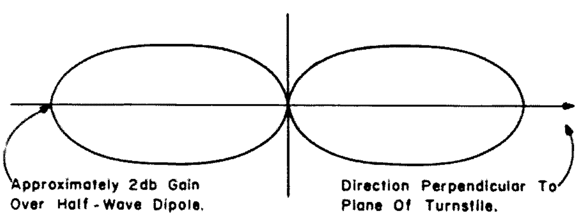
FIGURE 1B

one quarter wavelength, with corresponding (eighth-wave) end sections bent 90° to meet. Since the two dipoles are "in parallel," they are electrically in phase. The gain of a broadside 2-element array of half-wave elements spaced a quarter-wave is of the order of 1 to 2 db over a dipole. The end eighth-wave sections normally contribute little to radiation because of the small current which flows in them; hence, the loss due to bending these ends 90° is small—not over 1 db. Thus the



TURNSTILE RADIATOR

FIGURE 2A



HORIZONTAL RADIATION PATTERN
Turnstile In Vertical Plane

FIGURE 2B

net gain of the full wave loop is slightly under 1 db, with directivity perpendicular to the plane of the loop (broadside). (See Fig. 1b.)

The *turnstile* antenna, shown in Fig. 2a, is commonly used at VHF and UHF, with the dipoles in the horizontal plane, as an omnidirectional radiator with horizontal polarization and a gain in the horizontal plane of about –3 db. Along an axis perpendicular to the plane of the dipoles, however, the turnstile radiates with circular polarization and a gain of approximately 2 db over a reference dipole (Fig. 2b). This antenna is the basic element of the K6CT "dual diversity" array.

The third type of basic element widely used in parasitic arrays is the dipole itself, with a gain (by definition) of 0 idle db (one). The horizontal pattern of a horizontal dipole is a figure eight, as shown in Fig. 3a; that of a vertical dipole is circular, as in Fig. 3b.

Now we need some information about the pattern (and gain) of the basic parasitic configuration and we will be ready to analyze our three popular beams. Table I derived from calculations and measurements made in numerous professional labs, using conventional yagi arrays. Applying the pattern multiplication principle "backward," we divide the yagi pattern(s) by that of a basic dipole element in order to derive the pattern characteristics of an equivalent array of isotropic elements.

It should be noted that gain is more a function of total boom length than of number of elements; placing more elements than indicated by the table on a boom of the length specified results in only slightly increased gain (seldom much over 1 db). The operating bandwidth over which pattern and SWR remain fairly satisfactory is substantially reduced, however. The range of maximum gain values given in the table results from differences of opinion among various experts, and illustrates the considerable difficulty of making precise gain determinations.

The gain of a dipole (with respect to a dipole) is by definition 0 db. Pattern multiplication for parasitic arrays of dipole elements

TABLE I

Maximum possible gains of parasitic arrays of isotropic elements (referred to a single isotropic radiator)

No. Elements	Boom Length, Wavelengths	Max. Gain Range, db
2	0.1	5.0-5.7
3	0.3	7.0-8.7
4	0.5	8.7-9.5

More than 4: Add 0.4 wavelength boom length per element; Add 2.5 to 3 db gain for each doubling of number of parasitic elements, up to a maximum of about 20 elements.

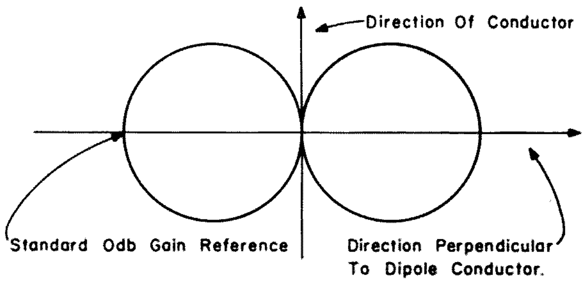
therefore yields exactly the same numbers presented in Table I, except that the gains are now referred to a dipole. The corresponding yagi gains relative to an *isotropic reference* are those given *plus* the 2.1 db gain of the dipole basic element over isotropic. Multiplying the *basic* array pattern shape of Fig. 4 by the familiar figure-eight of the dipole elements yields the well-known horizontal pattern of the conventional (horizontal) multielement parasitic beam (Fig. 5).

Applying the same approach to the cubical quad suggests a gain of about 5½ to 7 db maximum (5.0 to 5.7 db array gain plus about 1 db gain for the basic loop. The horizontal pattern of a horizontally-polarized quad is similar to that of the two element yagi; although the null off the quad element "ends" may not be quite as sharp because of the bent elements, the net current in each vertical member is zero and little vertically-polarized radiation occurs. It should be noted that the stacked-dipoles effect of the basic loop results in a slightly greater emphasis on low angle radiation from the quad when relatively close to ground (compared with a yagi at the same height). Experimentally measured quad gain figures have been slightly less than indicated by this analysis; the interested reader would benefit by reading the detailed discussion found in Ref. (5).

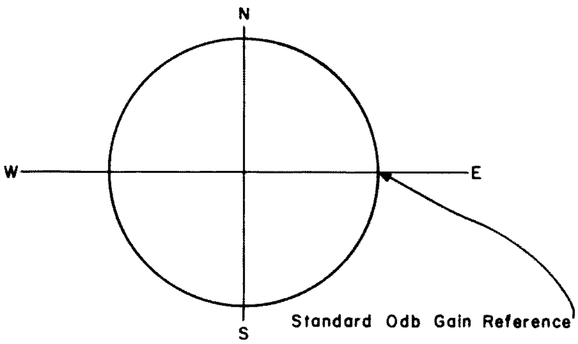
The K6CT "Dual Diversity" Array

The "dual diversity" antenna described in 73[6] is one for which results of precise, comparative performance tests are not yet available. For that reason it makes an interesting example for the application of our elementary analysis technique. We must realize that this simple approach cannot be expected to provide *precise* numerical answers, and that in some cases it may overlook factors significant enough to change the results appreciably. Thus, our estimate must always be subject to refinement on the basis of more exact analysis or the results of carefully controlled tests. So far, such data has not been published on the K6CT array.

Applying pattern multiplication to a three element parasitic array of turnstile elements yields a probable net gain of about 10 db (2 db turnstile gain plus 8 db array gain) over a dipole. This gain cannot be realized, though, unless the propagation medium permits the transmitted wave to arrive properly polarized at the receiving antenna. For a line-of-sight path, this means that the receiving antenna must also be circularly polarized, with the same



HORIZONTAL RADIATION PATTERN
Horizontal Half-Wave Dipole
FIGURE 3A



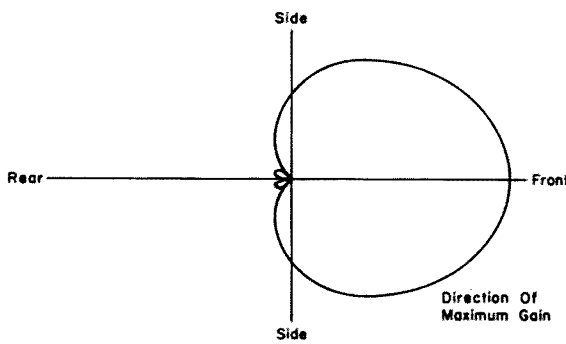
(Direction Of Dipole Conductor Is Perpendicular To Plane Of Paper)
HORIZONTAL RADIATION PATTERN
Vertical Half-Wave Dipole
FIGURE 3B

rotational sense as the transmitting antenna. Polarization shift phenomena in ionospheric skip propagation, however, makes this case more difficult to analyze.

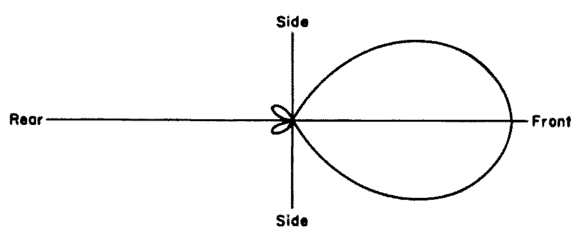
As a start, let's consider the K6CT array for what it physically is—a vertical yagi and a horizontal yagi, sharing a common boom and fed 90° out of phase. It can be proven that two yagis mounted in this fashion will not interact (except through the feedline), since each lies entirely within the other's plane of zero potential. (This suggests a practical means for interlacing beams for two bands without interaction worries, but that is another story for another day.) With this background, we can justify treating the array as two separate antennas, each receiving and radiating half of the transmitted power. If the array gain is 10 db, each yagi alone will yield half that, or 7 db.

Because of differences in vertical radiation patterns, a signal radiated by a vertical antenna and a signal radiated by a horizontal antenna in the same location generally will not follow the same path to the receiving antenna. In addition, polarization of a wave is often shifted to some degree during the process of ionospheric reflection. Consequently, it is most improbable that the two components of a signal from a K6CT array will retain both their polarization and their phase relationships. Since both characteristics are modified in transit by essentially random effects in the ionosphere, the two waves will generally arrive at the receiver with a random relationship in polarization, phase, and amplitude. In this case, they are just as likely to cancel as to reinforce each other. A complete analysis would require a statistical approach and considerably more propagation data than is readily available; it is probably safe to conclude that, on the average, the effective gain of a "dual diversity" array as described by K6CT will approximate 7 db. The polarization diversity effect may result in greater *apparent* gain, when compared with a single yagi, over a long path at any particular moment.

Neither K6CT's article nor our analysis here attaches any particular significance to the role of the turnstile feed system in providing an antenna with dual polarization. K6CT used it primarily as a convenient method of feeding his two yagis. George stated that the key to "polarization diversity" performance is the antenna's ability to radiate and to intercept both vertical and horizontal polarization equally well. If that is actually the case, then the function can be accomplished by mounting a single yagi with the elements tilted 45°. Something for nothing? Not quite—we lose the 2 db turnstile gain this way. But the configuration of the K6CT array makes it difficult for many hams to support and rotate it. It may often be easier to pick up the extra 2 db gain by lengthening



TYPICAL HORIZONTAL RADIATION PATTERN
Parasitic Array Of Isotropic Radiators Or Vertical Dipoles
FIGURE 4



TYPICAL HORIZONTAL RADIATION PATTERN
Conventional Yagi Array Of Horizontal Dipoles
FIGURE 5

the boom 0.2 wavelengths and adding a fourth element. This approach has been successfully used by the CB boys (you should pardon me for bringing it up here) and it just may be that one isolated occasion where we can learn something from them.

The extent to which the vertical radiation component of a polarization diversity array is doing the work will largely determine the F/B and F/S ratios of that antenna. The horizontal directivity patterns of typical vertical and horizontal yagis are shown in Figs. 4 and 5, respectively. (The vertical dipole's horizontal pattern is circular, like that of an isotropic radiator. Hence the pattern of a vertical yagi is similar to that of an array of isotropic elements.) If the vertical portion is contributing little compared with the horizontal portion, then the apparent array pattern will approximate that of a horizontal yagi. F/B is typically 15 to 25 db and F/S may be 25 to 35 db or higher. If the vertical yagi is contributing significantly to the signal path, however (which it must sometimes in order to justify polarization diversity), then the pattern will look more like that of Fig. 4. Consequently, a good share of the time, the diversity array must be expected to show a F/S as low as only 2 or 3 db. F/B should ordinarily run about the same as that of either antenna alone—certainly there is no reason to expect it to be better. The author has run preliminary tests on a pair of "dual diversity" arrays of the K6CT variety, and the results, though not precise, do tend to confirm the preceding estimates.

Conclusion

This article has underscored several of the more significant factors which must enter into the evaluation of an antenna's actual or potential performance. Application of the principles and facts presented here should enable most hams to arrive at fairly sound conclusions relative to advertising claims and the selection of that new beam. Better yet, it may even influence a few rugged individuals to page through an antenna manual or two, rummage through the neighborhood surplus yard, and then *build* themselves some exotic scenery. Antennas are one of the comparatively few remaining areas in ham radio wherein the home handyman can meet or beat store-bought gear with modest effort, save money (even considering trade-in!), and derive a sense of satisfaction.

. . . K6CTV

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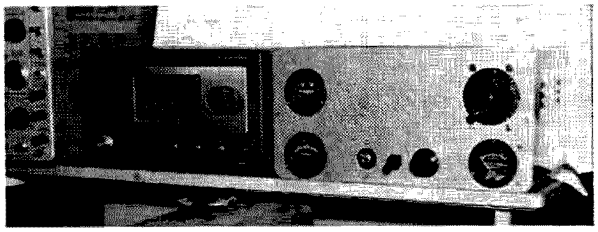
   (b) Messenger, "Dual Diversity Beam," **73,** 1:13, Oct., 1961, pp. 42-44.



How to Fill a Box

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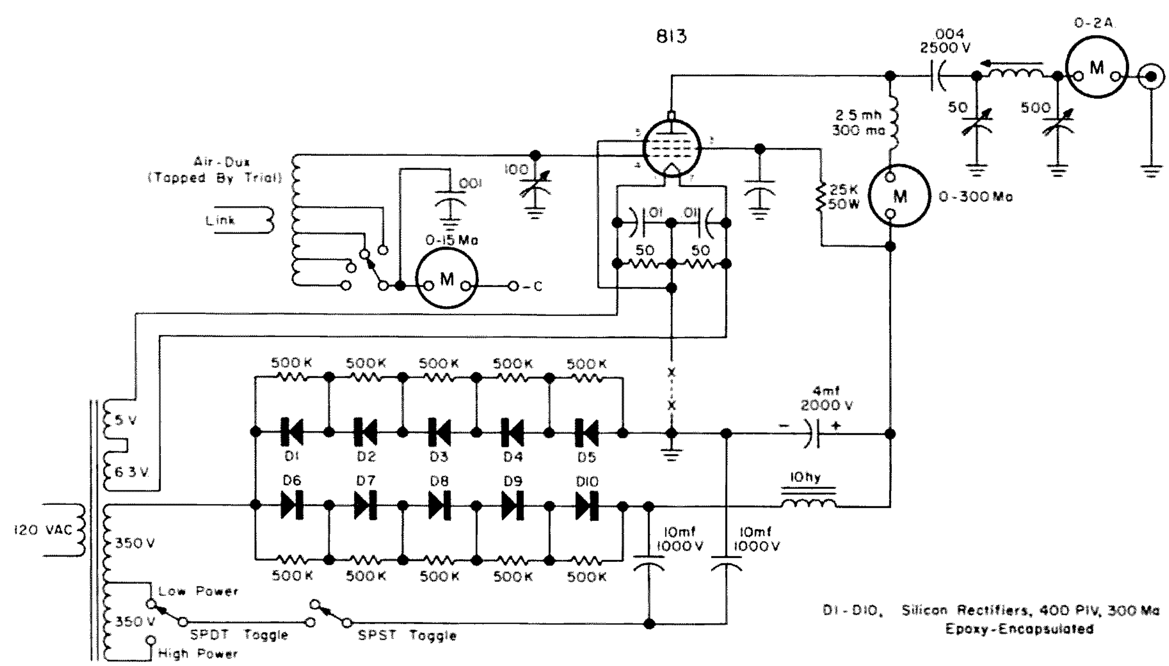
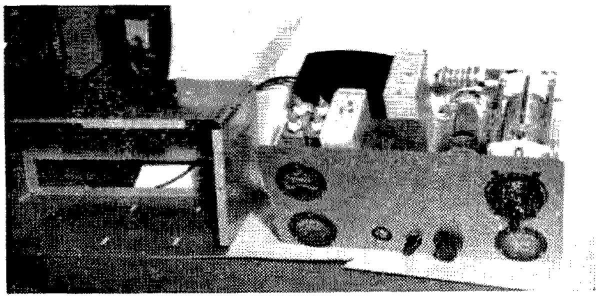
When you see a Jim Dandy metal cabinet with chassis and front panel at a bargain price, do you ever get a yen to see just how much stuff you can crowd into it? I suspect that this is one of the secret vices of that group of hams who get their kicks out of construction projects. It's something like not being able to walk past a surplus radio store.

Well anyway, when I saw WRL pricing a cabinet, complete with all of the above, for $2.98, the temptation was too much; in fact, I purchased two. I decided to build an 813 final amplifier, complete with power supply, all in this 15" x 7" x 9" box. The results may be viewed in the illustration.

Construction

When you anticipate mounting this much hardware on a chassis you spend a whole day just figuring out where to punch the holes, what size holes to punch, finding the necessary punches and drills to do the job and, last but not least, punching said holes. It helps to either own the necessary punches or have a friend who will loan them. Various holes were punched or drilled to satisfy the needs of transformers, meters, dials, chokes, filter condensers. etc. The roller coil, resurrected from an old BC-375E, was mounted on bushings behind the panel and the 813 was mounted horizontally with the plane of the filament in a vertical position. Under the chassis a tapped grid circuit was placed next to the front panel. The resonating and loading capacitors of the plate circuit are to the rear. Actually, plate tuning is achieved by turning the roller coil from the front, though the resonating capacitors may be turned by reaching behind. It is a double





spaced midget dug up from the junk box which, when clear meshed, just tunes the tank circuit on 80 meters. The loading capacitor is a 500 mmfd single spaced job and of course needs adjustment once per band. The rest of the component placing should be self evident from the photograph, with the exception of the silicon rectifiers which are mounted under the chassis with 500K resistors shunted across them on a fiber terminal strip.

The circuit of the amplifier is a straight forward arrangement with band switching in the grid circuit by means of a tapped coil. The combination roller coil and tank capacitor in the pi-network of the output will reach all bands. Neutralization has been left out for want of space for a neutralizing capacitor. The amplifier is stable on 80, 40, and 20 without neutralization. If much were to be done on 15 or 10 some method of neutralizing should be incorporated. Possibly a reversed link could be used.

The power supply utilizes a 700 v transformer resurrected from antiquity, but any TV replacement transformer will work. The rectifiers are 400 PIV 300 ma 25 cents a piece items available from almost any bargain sheet. These are bridged with 500K ½w resistors to insure equal voltage division or inverse peaks. The low-high power switch makes it possible to operate at half or full voltage. The 5 and 6 volt filament windings are connected in series to furnish 10 volts for the 813. With the power switch off the voltage is a little high but is about right when the power supply is turned on and loaded.

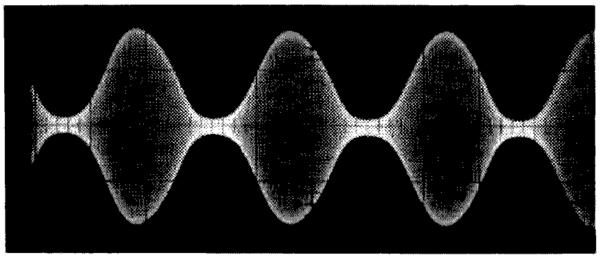
Operation

The photo shows the 813 amplifier being driven by an HT 18. This furnishes about 4 watts of drive which is sufficient drive for anything but plate modulation. Fireworks would result if you tried to plate modulate an amplifier of this size with the spacing provided in the box anyway. Using the NFM exciter pictured I get about 125 to 150 watts output with an input between 200 and 250 watts. Gridleak bias is satisfactory for this mode of operation. If CW operation is to be used, part of the bias should be battery, causing the plate current to drop just sufficiently to be within the dissipation rating of the tube, but not low enough to unload the power supply. If the power supply were switched to the low voltage position it would be alright to operate with class C battery bias on CW.

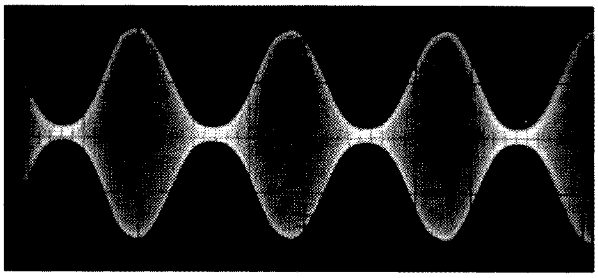
Several varities of AM were tried. Perhaps the best and cheapest was the use of a series 6AS7G cathode modulator. With this circuit the effective voltage of 813 is down to about 1200 volts or less and plate current will run around 125 ma when properly loaded. With this arangement about 60 watts of well modulated *if* output is obtained, as can be seen in the accompanying photo taken with a polaroid attachment for a Tektronix scope.

As with all methods of variable efficiency modulation the loading must be heavy and the excitation must be reduced to a lower value than when operating CW.

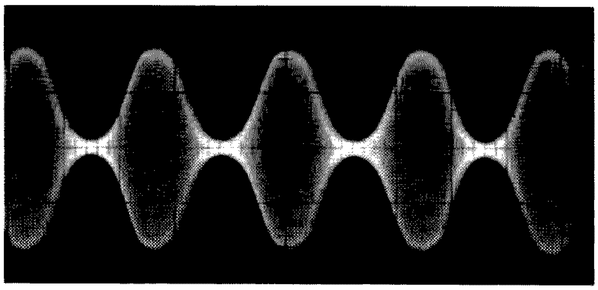
Standard grid modulation using battery bias and transformer coupling works very well also. In this case the voltage goes to about 1600 volts with a plate current of 115 ma. The efficiency is lower but the added input brings the output to about the same value. The 813 shows a little color. Excitation and loading is



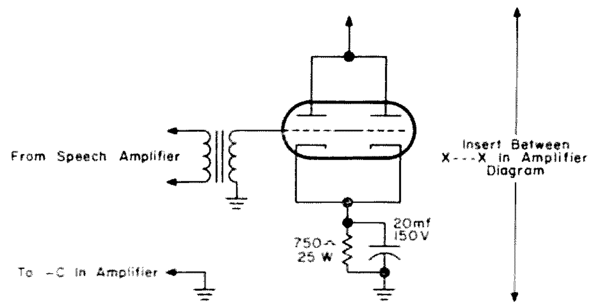
Series cathode modulated 813



Grid modulated 813



Class B linear 813, driven by 6K6 plate and screen modulated



SERIES CATHODE MODULATOR

a bit more critical than with the cathode modulation but, as can be seen from the photo, the pattern is about the same.

Using fixed bias in the neighborhood of 175 volts (this seems high but seemed to be the value for our particular 813 of unknown history) the amplifier works very well as a class B linear AM amplifier. Not having AM in the exciter pictured we used parts of an RCA demonstrator which had a single 6K6 plate and screen modulated. The plate voltage and current value of the 813 stage were about the same as with grid modulation. As can be seen from the pattern, there is slightly more tendency toward flattening.

If the resting current were held to about 75 ma (to avoid too much voltage variation) the amplifier should work ok as a SSB linear. This was not tried.

All in all we got quite a bit in a very small box and it will serve very well for our portable needs which call for a little power.

. . . W7CSD

Ha

Four Bands on the KWM-1

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With the declining sun spot cycle and loss of availability of the higher frequencies, the usefulness of the KWM-1 is limited by the lack of 40 & 80 meters. I decided I would try to put mine on 40 meters with the idea that the original 3 bands would not be affected in any way and no holes would be put in the front panel or cabinet. I succeeded to the extent that it can still be operated exactly according to the instruction manual with no apparent changes and yet, with a few simple adjustments, it operates on 40 with equal facility.

The first change, and one you may want to make even though you go no farther, is to make the unit operate on either upper or lower sideband. This is comparatively simple and anyone should be able to do it. The only parts that are needed are a plated crystal and socket, and a spdt slide switch. The crystal * should be calibrated to .01% or better as measured into a 32 mmfd input capacity. To find the proper crystal frequency take the BFO crystal frequency and subtract 455 kc from it. Then taking this number subtract it from 455 kc and you get the lower sideband BFO crystal frequency. For instance, my crystal was 456.95 kc, subtracting 455 kc I got 1.95 kc. Then subtracting 1.95 kc from 455 kc I got 453.05 kc.

Before installing any parts drill a 1/32 inch hole through the slide button of the switch. Install the crystal socket to the right and slightly forward of the present crystal socket XY1 on the chassis and tie the two adjacent terminals on the crystal sockets to pin 1 of V9. Mount the spdt slide switch on a small aluminum bracket directly below the crystal sockets and tie the center of the slide switch to pin 6 of V9. Tie the outer terminals of the crystal sockets to the outer terminals of the slide switch. Put a 6 inch piece of 1/32 inch piano wire through the hole in the switch button and place a right angle bend in the wire above and below the button and run the other end out through one of the holes in the case (see Fig. 1); bend an end on it and trim to a convenient size so that you can throw the switch. This will allow you to operate on either upper or lower sideband. Although the Collins KWM-1 book says this crystal should match the mechanical filter, I ordered the new crystal, as calculated, and it worked very well; in fact, I have tried 3 different 3.1 kc Collins filters with it and there was no noticeable difference.

To put the KWM-1 on 40 meters it is necessary to extend the range of the four exciter tune coils. Since they are designed to tune from 10 meters to 20 meters by increasing the

* From R. E. Woods Electronics, 2164 North Parkway Drive, El Monte, Calif. for $4.95 plus tax and postage.

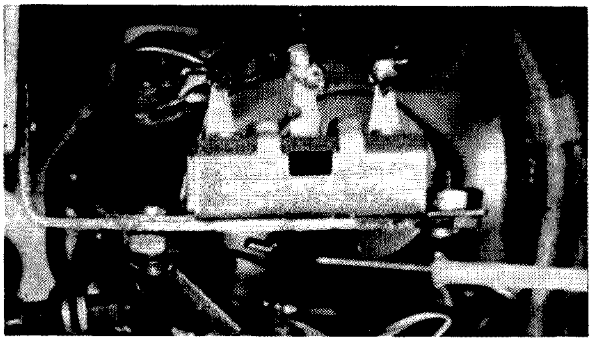


Fig. 1

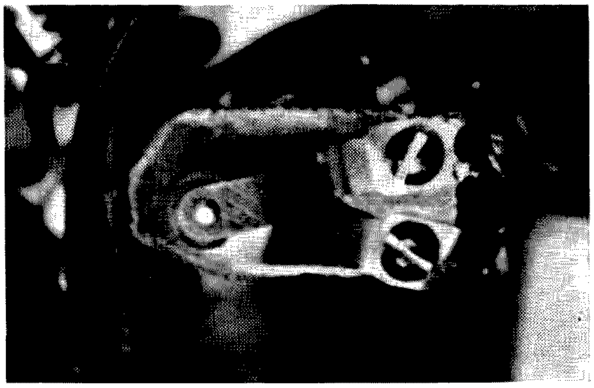


Fig. 2

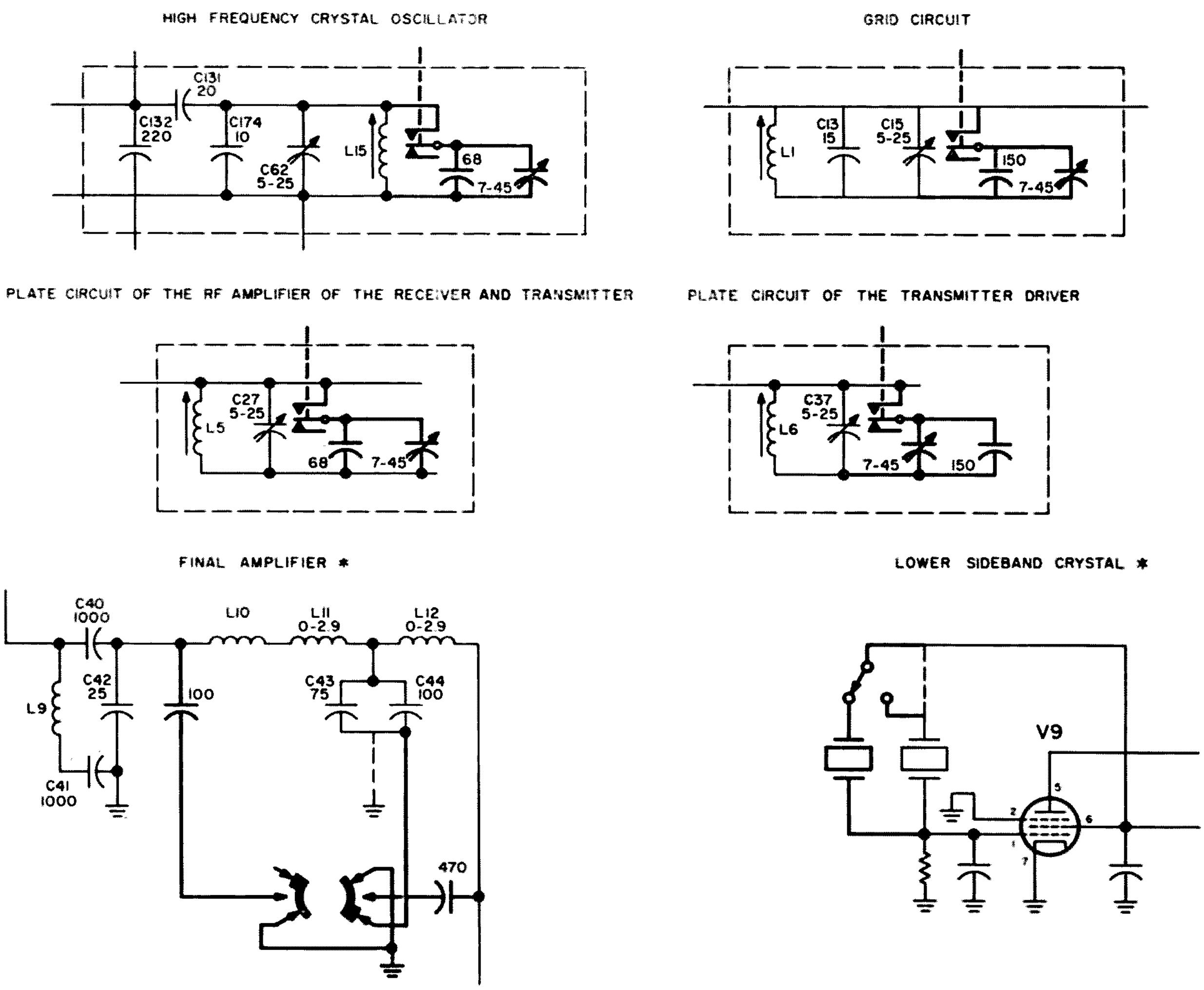
inductance with the slugs, it is possible to add enough capacity to go to 40 meters and still maintain approximately the same LC ratio as it has on 10 meters.

The first step in putting the KWM-1 on 40 meters is to check the exciter tune control. This should peak the lowest frequency you use on 20 meters not lower than the 15 calibration. If it is lower, retune so it is between 15 and 16 as follows: Tune up on 20 meters with the meter switch in PA grid and the emission switch in tune. Turn the PTT on and advance the mike gain until the meter indicates. Move the exciter up a little and repeak the 4 slugs as indicated on the meter. Reduce or advance the mike gain to get indication but keep it at a minimum. You may have to do this in two or more steps to move it the required amount.

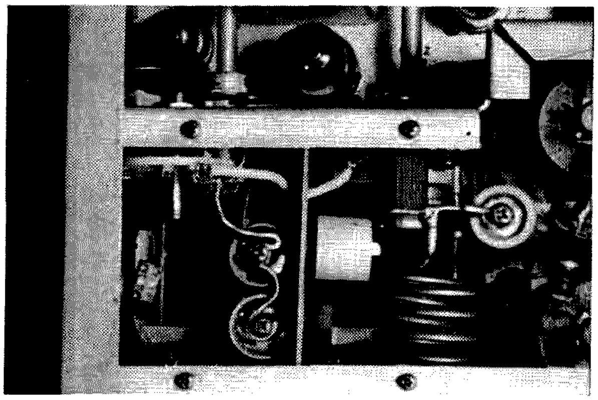
Now tune up on 10 meters and peak C62, C15, C27, and C37 just as you peaked the slugs on 20 above. These are the capacitors in the cans, next to the slugs, accessible from the top of the chassis, right under the exciter tune bar. After you get the capacitors peaked for 10, you go back and repeak the slugs on 20. You repeat this process until no additional improvement is apparent and 20 tunes high enough so that you have room to tune 40 below it. Then the KWM-1 should be in tune and tracking on 10, 15, and 20 and you are ready to proceed with the construction.

The next step is to build switches for each of the exciter tune coils using relay parts from Guardian kit #200-M3. Cement pieces of fibre board (approximately 1¼ x ⅝ inches with ¼ inch hole in one end to fit over coil form) to the coil form with Duco cement and mount the relay leaves on these so that the contacts will close when the exciter tune control is about 14½. Use ¼ inch lucite rod threaded with a ¼-20 die (or narrower rod to fit inside the coil form) ¼ to 7/16 inches long above the

EXCITER TUNE CIRCUITS *



Changes and additions are indicated by heavy lines.



slugs to actuate the relay leaves and thus close the switches. Adjust the length of the rods and the position of the relay leaves so that all four switches close at about the same position—about 14½ so that they open soon enough to peak 20. See Fig. 2 for more details.

Mount a 7 to 45 mmfd trimmer (Centralab 822BN, 825BN, or Erie TS-E) in the top of each can that goes over the coils so that it can be tuned with the can in position. Be sure the trimmer does not interfere with the switch action or short the switch to ground. Use about a #28 insulated flexible wire to connect these trimmers in parallel with the disc ceramics to be added. (See Fig. 2)

On each coil solder in a disc ceramic of the proper value and wire in the trimmer so that when the switch is closed they are in parallel with the original capacitor in the tuned circuit. Add a 68 mmfd capacitor and the trimmer in parallel with C62 and C174. Add a 150 mmfd capacitor and trimmer in parallel with C13 and C15. Similarly a 82 mmfd capacitor on C27 and a 150 mmfd capacitor on C37.

Get a crystal for 40 meters and plug it in any socket of the crystal box which you can spare. The frequency of this crystal is simply the bottom frequency of the band you want plus 4 mc and divided by 2. For instance, if you want 7200 kc for 40 phone, then by simple math $(7200 + 4000) \div 2 = 11200$ kc $\div 2 =$ 5600 kc (.01% xtal into 32 mmfd input). If you have followed all steps so far, you should hear 40 meters when you use the crystal and peak the exciter tune between 14 and 15, although nothing has been tuned up yet.

The next step is to convert the final to tune 40 meters. Install a rotary ceramic switch with at least 2 poles in the front wall of the high voltage compartment. Connect one end of a 100 mmfd mica condenser to the hot end of C42 and the other end to the ceramic switch. Lift C43 and C44 from ground and connect the ground end to the switch by taking them off the divider wall and mounting them on a #14 to #18 wire connected from the juncture of L11 & L12 to the switch. Let the ceramic parts of C43 and C44 rest against the wall for support. Finally connect a 470 mmfd silver mica capacitor from the output end of L12 to the switch. See schematic for switch connections. By drilling an 1/32 inch hole in the switch knob and using a piece of bent piano wire out through the side cabinet holes, you can actuate the switch without opening the cabinet (see Fig. 3). If you desire, you can align the switch with the anti-vox control and use a shaft through this hole to control the final switch. If this is done, put the anti-vox pot on a dual coaxial pot with the vox gain and you still haven't drilled a hole in the cabinet.

This completes the conversion and all that remains to be done is the tuning. Set the exciter tune control about half way between the stop and where the switches open. Get a strong signal on 40 meters from a signal generator or the calibrate position of another transmitter and peak the trimmers on the front three exciter cans. (Note: cans must be in position over coils). Now, with the meter in grid position, quickly set the fourth trimmer approximately in tune the same way you did for tuning in the beginning. Next set the PA tune to 0 and dip the final with the PA load control. Finally, peak the four trimmers with the meter in grid as described before and the job is done.

The final has been changed from a pi L to a pi network on 40 meters only so the two coils are in series and it is only necessary to tune the load control on 40 meters.

Your KWM-1 will work exactly as it always has, but when you switch to the 40 meter crystal and peak the exciter tune between 14 and 15, you will hear 40 meters on the receiver just like you hear 10, 15, & 20. Throw the switch you have installed on the final and tune up by tuning for a dip with the load control (the final tune is at zero) and you are ready to operate on 40 meters. . . . K6GHU

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65 foot 80 Meter Dipole

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With the rash of new SSB multi-band transceivers hitting the market these days, more and more amateurs will be presented with the problem of installing 80 meter antennas. Those of us who live in houses located on small lots have a problem. The following is one solution.

There is nothing new about inserting an inductance in series with an antenna to shorten the mechanical length, or connecting two or more dipoles to one coax feed line. However, finding descriptive information for the construction of such antennas is difficult.

Those amateurs who have a 40 meter dipole antenna but lack space for a full length 75 meter dipole can, for $3.50, put up a 75 meter antenna using the same space, same supports and feed line as the 40 meter antenna. The only expense is the purchase of two loading coils and necessary antenna wire and insulators.

As to the results of this antenna, the following can be said . . . when compared to a 23 foot vertical with a bottom loading coil, there is a radical improvement on 75 meters. During a 30 minute period the other evening, contacts were made in Texas, Georgia, Hawaii and Oregon. Signal strength was 9 or above with the exception of Hawaii.

The construction of the antenna is illustrated in Fig. 2. The loading coils are located 20 feet from the feed line. The high current portion of the antenna takes place in this first 20 feet, allowing the use of number 18 wire in

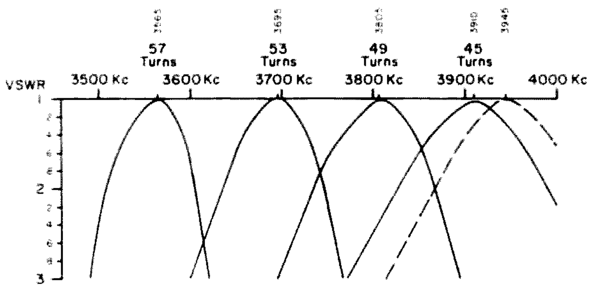

FIGURE 1

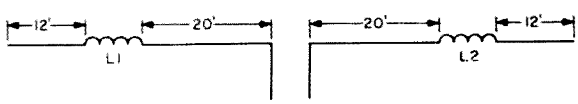

FIGURE 2

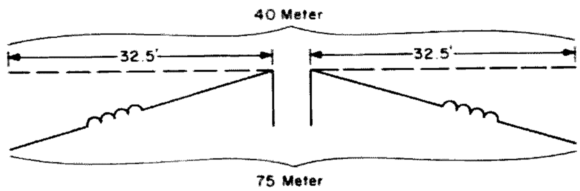

FIGURE 3

the loading coils. 12 feet of wire connects to the other end of the loading coils.

The loading coils are B & W type 3023. Turns are removed to tune the antenna to the desired frequency. Refer to Fig. 1 for correct number of turns.

Plastic strips ½ x 4 inches were cemented to the coil forms. Holes were drilled in either end of the strips. 6-32 screws were used to connect the antenna to the strips and either end of the coils. The plastic strips act as strain insulators as well as supports for the coils. Discarded toothbrushes will yield enough plastic strip for your installation.

Plastic sandwich bags were slipped over the loading coils for protection from snow, ice, rain, dirt and birds. (Southern California installations delete words snow, ice and rain.)

Fig. 3 shows installation of the antenna to an existing 40 meter dipole, using the same coax. Strain insulators are connected to either end of the 75 meter antenna. The ends of the 75 meter antenna are tied to the 40 meter antenna supports. The spacing between the 40 and 75 meter antennas is not critical as long as they do not touch each other.

Fig. 1 charts VSWR characteristics vs frequency. Number of turns pertain to each coil L1 and L2.

Check out procedure for the antenna after installation is as follows. Assuming that the 75 meter phone band has been selected and the loading coils have been adjusted to 45 turns, load the transmitter to the antenna. Change the frequency for minimum VSWR. Let's assume this takes place at 3950 kcs. The dotted curve on Fig. 1 indicates such a condition.

To cover the phone band with a minimum of VSWR, it is desirable to have the resonant point at approximately 3900 kcs. To accomplish this it was only necessary to increase the length of one end of the antenna by 3 inches.

During the process of adjusting the antenna, each end of the antenna should be varied by the same amount if the adjustment requires more than 6 inches.

The 12 foot section of the antenna should be cut to 13 feet. The extra foot of length can then be twisted back over the 12 foot section. This will leave approximately one foot of wire that can be used for adjustment without splicing.

The exact length will be dependent on the installation. Surrounding objects will cause the end loading to vary. The added one foot of length should be adequate to compensate for these variations.

A VSWR indicator is desirable to make these adjustments. If one is not available, the transmitter will suffice. Vary the frequency of the transmitter until the maximum antenna load is determined. This will be the point of minimum VSWR.

. . . W6LVT

The Drake 1B

Floyd O'Kelly W5VOH
418 East Hickory
Midland, Texas

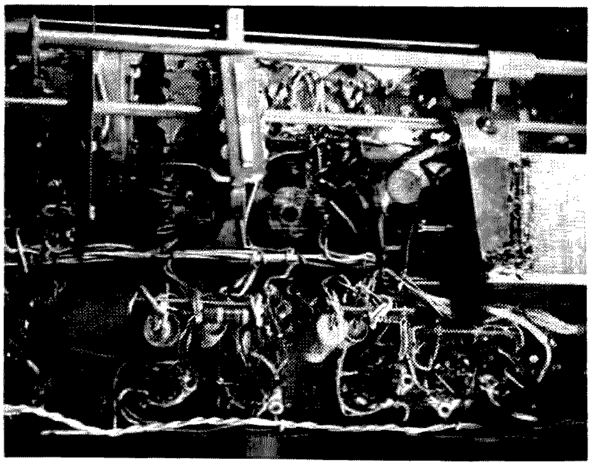

Photo 1.—A top view of the receiver. Note that a bead of solder extends the full length of the sideband selection box.

The Drake 1-A receiver is an excellent ham band receiver that was designed primarily for single sideband reception. CW is also received with ease, but AM reception leaves something to be desired. It is true that AM can be received by the exalted carrier method, but if the AM station is not stable, FM's or if several AM stations in a QSO are not exactly zero beat—which is more the rule than the exception—it soon becomes desirable to have available a detector more suitable for AM.

This is easily accomplished in the Drake 1-A and the price is probably within the reach of every Drake 1-A owner—72¢. The big fear of drilling a hole in the panel or cabinet is unfounded for this modification as the switching from AM to CW-SSB reception has been resolved by doubling up on one of the existing

panel switches—the antenna trim control. Some of the later model 1-A Drakes have already doubled up on this control and use it to switch in the crystal calibrator. This will not, however, alter the SSB to AM conversion except that the antenna trim control will have a triple function.

The antenna trim shaft is removed from the antenna trim condenser and a quarter inch shaft coupler is slipped onto the fibre rod. The shaft is then reunited with the trim condenser and the quarter inch shaft coupler is moved up the shaft to a location about three inches from the front panel. (The exact position will be determined later.)

A bracket should be made from a heavy copper strip and bent as shown in Figure 1. The "Top Lip" was tinned with solder on the bottom side to expedite easier soldering later. A small double pole double throw slide switch was mounted on the bracket as outlined in Figure 1 and the photo. (It is advisable to wire the switch before mounting the bracket.)

The bracket is bolted to the chassis with an existing lug that is used to tie down one of the IF cans. The other end is soldered to the sideband selection box that contains T4. (See Photo.) Do not solder, however, until the following steps have been completed:

Insert a half-inch long bolt into one of the tapped holes in the shaft coupler. Move the shaft coupler until the half-inch bolt is centered over the slide switch. Tighten the bolt and the shaft coupler's set screw to the antenna trim shaft. Move the copper mounting

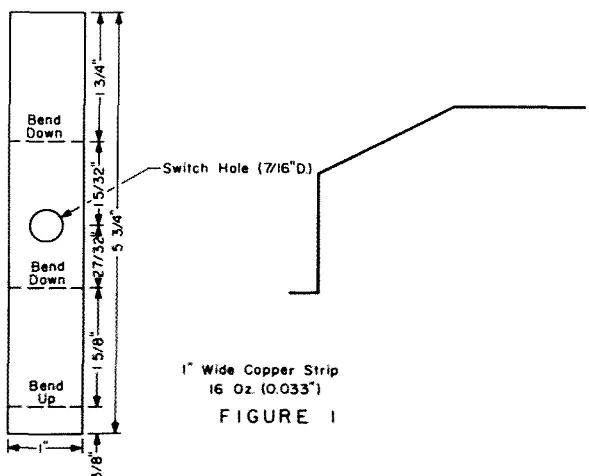

Fig. 1.—A template of the copper brocket constructed to place the DPDT SSB-AM switch near the antenna trim control shaft. Copper was used because of its availability and ease of soldering.

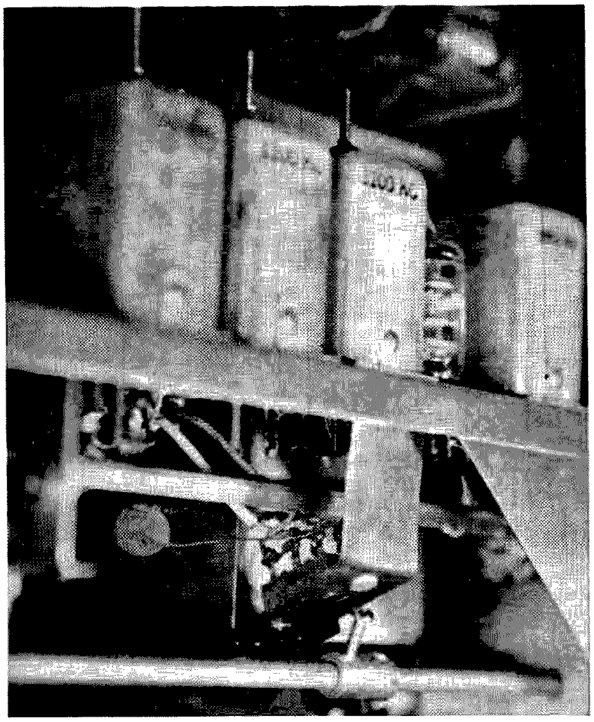

Photo 2.—A side view of the conversion showing the position of the switch, shaft coupler and mounting bracket.

bracket until the bolt in the shaft coupler will slide the switch in both directions by rotating the antenna trim shaft approximately 330 degrees. Solder the copper bracket firmly to the side band selection box. This completes the mechanical portion of the conversion.

The wiring is very simple and straight forward, particularly if the switch was prewired before mounting. The use of shielded wire is recommended, but care should be exercised if the non-insulated type is used to avoid shorting out some portion of the receiver. The .005 coupling condenser used had sufficiently long leads to reach from the switch to the AGC terminal board, as shown in the photo. However, another Drake 1-A (judging from the serial number a much earlier production model than the one used in the photo) did not have the terminal board and it was necessary to add an extension to the coupling condenser to reach the 6BF6 tube socket. The 270K ohm bias resistor was mounted on the slide switch—this should be done before mounting the bracket.

A shielded wire is used in the Drake 1-A to connect the grid of V8 to the cathode of V-10 (see schematic for detail). Disconnect the shielded wire from V-10 and it should be long enough to reach the new switch. A new length of shielded wire is used to connect the switch to the cathode of V-10. This completes the wiring and the conversion, so turn on the receiver and check for proper operation before replacing it in the cabinet.

The AM-SSB switch performs two functions when switching from sideband to AM—it removes the first audio amplifier from the product detector and switches it to the AM detector (combination AM detector and AGC rectifier), and it stops the BFO from oscillating by grounding the feedback.

The new Drake 1-B receiver will perform on sideband and CW as before, except, of course, the new SSB-AM switch should be in the SSB position. AM is received by rotating the antenna trim control until the slide switch is moved to the AM position. The sideband selection control may be placed in either the upper or lower sideband position. The choice can be determined by the QRM and optimum voice quality.

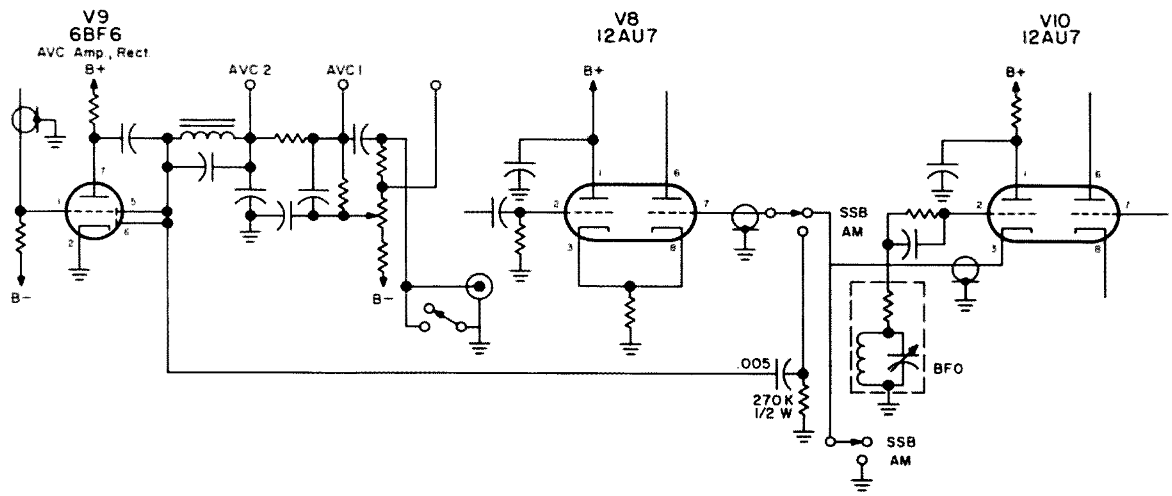

FIGURE 2

Fig. 2.—A schematic of the converted portion of the receiver. Only the new conversion components have values.

I am sure that if you own a Drake 1-A receiver and have the occasion to contact AM stations, you will find this conversion worthwhile, but prepare yourself for a shock. The excellent bandpass qualities that are so noticeable on sideband will also be present in the AM position. It's damn sharp—the stations are either rocking the speaker or absent. However, in the crowded conditions of the present day bands this will work to your advantage. The conversion is simple, inexpensive, can be completed in less than an hour, will not harm the sideband receiving ability, and will increase the versatility of an excellent receiver.

So, if you are thinking of trading your old 1-A for a newer model because it does not have AM receiving facilities, make this conversion and announce with pride, "The receiver here is a Drake 1-B." . . . W5V04

(W2NSD from page 30)

if the amateurs do not live up to the rules in 12.0 that we may lose frequencies. Next they say, "A most significant trend has developed in the last few years which has caused increasing concern to the League as to whether the basic purposes and objectives of the amateur radio service . . . are being and may continue to be adequately achieved."

They then go on to tell the FCC that this "trend" has arisen because they eliminated restricted voice bands back in 1951 and because manufacturers are turning out too much good equipment. The remainder of the petition is taken up with a long list of ARRL Board resolutions and their proposed solution to the "trend," a turning back of the clock to pre-1951.

Frankly I am incredulous that the ARRL Board and its General Council would send such a petition to the FCC. Either they are so caught up in their own arguments that they fail to see the obvious or else they are so sure that they can jam this through by the use of political pressure that they don't feel that they have to stoop to rational justification of their proposals.

The ARRL says there is a trend, they identify its causes and propose solutions. But never once do they in any way identify this trend. And further, they make no attempt whatever to document that their unidentified trend does in actuality exist outside of their imagination. Unless there is some political "fix" in it would seem to me that the ARRL petition should be rejected flatly and immediately by the FCC until the ARRL is able to present a definition of the trend which has caused all this difficulty

(Turn to page 86)

Noise Reducer

Charles Landahl W5SOT
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Los Alamos, New Mexico

A noise reducing receiving adaptor is described which takes advantage of the fact that a transformer produces voltages of opposite polarity at its output

In this gadget, these voltages, be they from noise or signal, are rectified by crystal diodes and made to appear across a potentiometer where the combined voltages can be equal to zero or plus and minus some value other than zero between ground and the arm of the potentiometer as it is moved up or down from its center position. Through the use of two similar transformers separated by a tube amplifier, phase shifted combinations of the plus and minus noise voltages can be achieved which cancel out on the potentiometers at a point different from CW signals. This feature alone can significantly improve the ability of a person to copy code signals through strong power line buzz, atmospheric crash static and Loran pulse noise. The basic circuit is shown in Fig. 1.

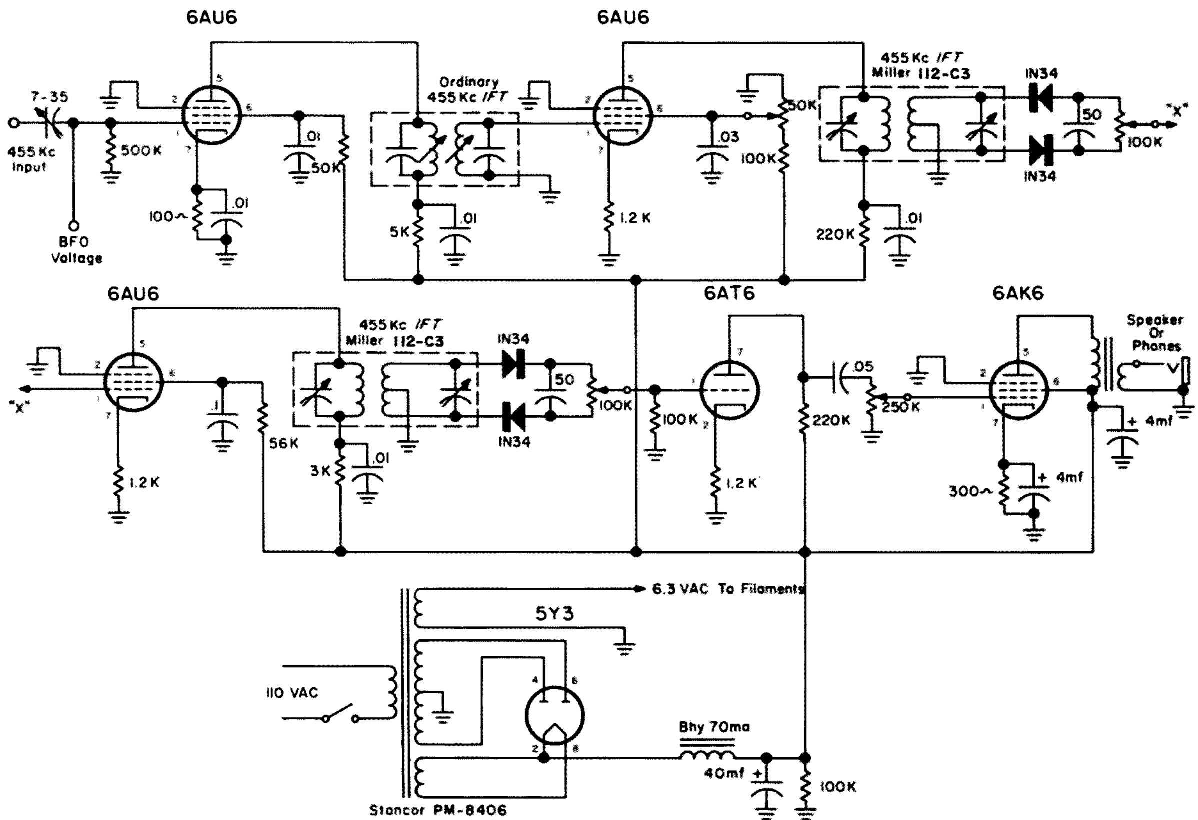


FIGURE 2

In order for the circuit to do its job well, it has been determined by experiments conducted since the start of the project (May 1957), that two stages of intermediate frequency amplification ahead of the noise reducing circuit are needed for most applications. A complete schematic of the adaptor is shown in Fig. 2. The first amplifier in the string receives its signal through a small series capacitor attached to the plate of a conventional first mixer tube in the station receiver. The first amplifier also receives the beat frequency oscillator voltage. This will be referred to again later in this discussion. The second *if* amplifier has a gain control in its screen voltage supply, and, under strong signals, can be made to work as a limiter stage. Under weak signal conditions, it can also be operated as a normal *if* amplifier. The noise reducer stage receives its signal from the arm of a 100K pot. By adjusting the two 100K potentiometers, voltages are produced which have either negative or positive going values for driving the grid of the first audio amplifier. Moreover, by varying the screen voltage of the limiter stage, changes in amplitude as well as small changes in phase shift can be made in these voltages prior to making them audible for listening purposes. The net effect of the noise reducing system is variable audio bandpass from zero to something over 6 kilocycles wide. The operator is able to select a signal to noise ratio which can improve his ability to read a signal through some discouraging noise conditions. This feature is a valuable enrichment since it has been found that a power line leak can be cancelled

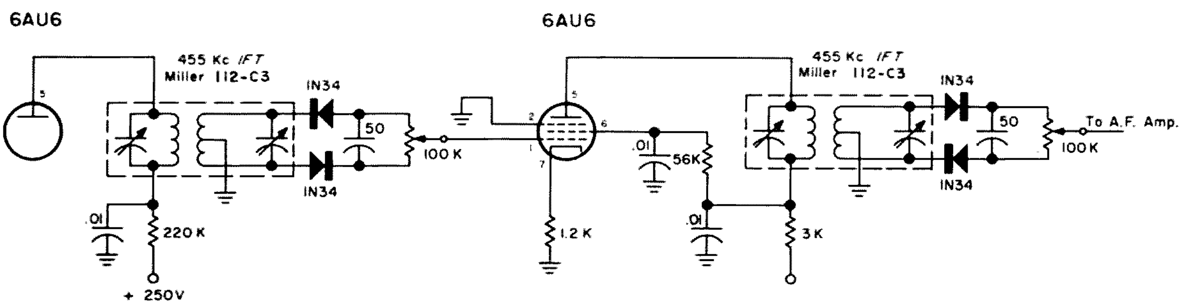


FIGURE I

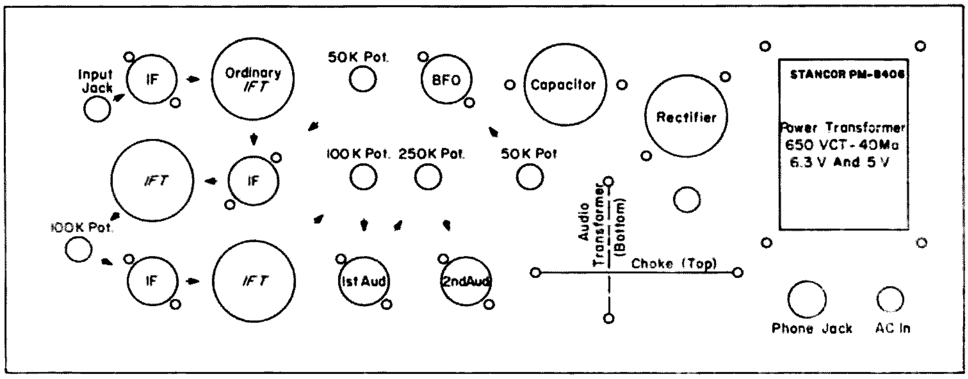


FIGURE 4

out and the code signals brought through for good copy. At the same time, the station receiver, beyond the 1st mixer, was totally blanked out by the buzz.

An important part of the system is the bfo voltage. This voltage needs to be variable from a low value to a value large enough to saturate the first two amplifiers. An adequate range is 0 to 20 or so volts of 455 kcs signal. Fig. 3 shows a suitable circuit. Another is described on page 224 of the 15th edition of The Radio Handbook. When static or noises are severe, crank up the bfo signal until the limiter stage begins to squeeze the crashes or pulses into tolerable listening levels. This will usually take place at some low setting of the 50K pot located in the screen supply of the limiter. The gain of the noise reducer stage is adequate to

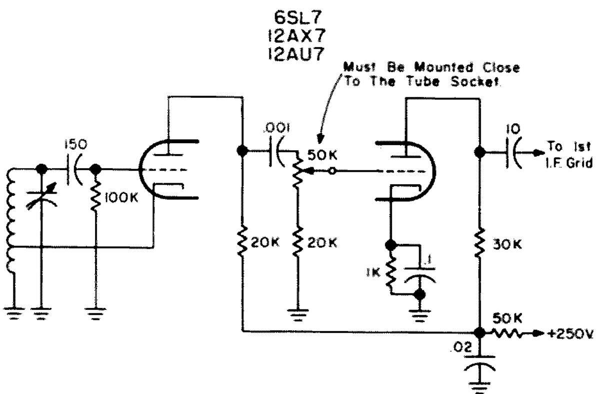


FIGURE 3

Note: This oscillator is separate from the bread board adaptor because I happen to have one made up in a separate shielded box.

amplify the weak audio left over from this squeezing process. All that remains is to jockey the 100K pots until the noise has been balanced out, or, reduced to the point that CW is readable. The system appears to work best on periodic noises such as 60 cycle buzz, ac-dc motors, and Loran pulses; however, it will attenuate atmospheric static and lighting crashes.

The circuit as shown in Fig. 1, requires center tapped secondaries on the *if* transformers. Miller #012-C3 work well with IN34 crystal diodes. It is suggested that the 100K potentiometers be of good quality. Normal construction practices were used on the adaptor and the bread board unit was assembled as shown in Fig. 4. The arrows indicate direction of signal flow or a control associated with a tube or transformer. The components were mounted on a steel chassis plate of 5" x 13" x 1/16" thick. The indicated layout places the potentiometers near their transformers and the shafts are in the clear for ease of adjustment.

A second detector was not incorporated because the CW and SSB sigs are hetrodyned in the first *if* amplifier. When the BFO is turned off, there are enough non-linear elements in the circuit to demodulate ordinary AM signals. In fact, under some conditions of summer static, it is best to leave the BFO running, zero the AM signal, and vary the amplitude of the BFO for best synchronous detection. This is a bit like 'exalted carrier' operation and tends to make voice signals more readable under adverse conditions. Finally, when noise is not a problem, run the potentiometers up toward the end of

their travel and the unit becomes a rather ordinary amplifier strip.

The noise reducer carries no claim of being the ultimate in noise free reception. Variations to be tried in the future include the 'Like New Mixer' circuit described in the February issue of 73. At this station the device is being used on 80 and 160 meters to good advantage. It is the culmination of many pleasant hours of old fashioned experiment, and hopefully may find some use in the radio shacks of the amateur fraternity.

. . .W5SOT

B & W Filters

Six meters is one of the most active ham bands these days, but due to its proximity to channel 2 many fellows have shied away from it, and some have who have built up equipment or invested in commercial gear have been plagued by those rascally indians. It is a shame to have troubles like this when they are so easily cured by the use of a good low pass filter.

Barker and Williamson have just recently come out with two such filters, one for medium power and the other for the high power crowd. The medium power unit, Model 423, will handle up to 100 watts up to 52 mc and reduced power above 52 mc. Its passband is 30-54 mc. The design consists of three sections, an input and output "M" derived section and a middle "K" derived section. It has SO-239 input and output connectors. Price is only $9.66.

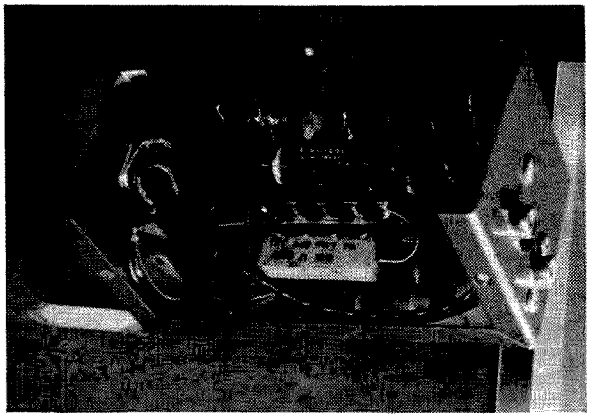
The high power model, 427, will handle a kilowatt and gives better than 60 db attenuation from 62 mc through the TV and FM channels. This has five tuned sections, "M" derived for the input and output and three "K" sections in the center. $19.86.

We checked out both filters here at the 73 labs, first running a curve on the passband with our sweep generator. This backed up the published specifications, showing B & W to be on the conservative side. Next we brought out our worst six meter TVI generator and ran it through the filter with our extremely susceptible RCA television set in the next room. Though channel two just barely creeps in here and is normally wiped clean by just about any six meter rig, were able to watch the usual dull trivia all the while the six meter rig was being used.

The B & W filters work, they're reasonably priced, they're small.

Better Results With AM

Bert Viney VE3AZX



Low powered AM has its frustrations and its good points, but it is ham nature to want just a little bit more in range covered.

For some time I have been seeking a means of improving two low powered commercial transmitters without getting into a major rebuild program.

Negative Cycle Loading appeared to be the answer.

The earliest clear explanation in the ham magazines was January 1959 W2NSD CQ. The article was ritten by Lee Shacklee W6PQW who have full credit to that all time great of ham radio, John L. Reinartz K6BJ.

The circuit was also described in QST for October 1956 by W4FHF as the "Ultramodulation System." It was complicated and expensive.

A slightly simpler version by W6MDI appeared in QST for November 1958 as a "Positive Peak Extender."

Another reference to it by W6WYD in May 1962 QST "proves" mathematically that it won't work. Which reminds me of the aeronautical engineer who proved that Bumble Bees can't fly.

For those of you who haven't files that far back, the theory goes like this:

In ordinary AM certain theoretical requirements are necessary for optimum transmission. These are: (1) The Class C final must on the downward half cycle of modulation just reach zero plate current. Carrier must not be cut off

Instantaneous Values

Cycle	Plate Current Class C	Plate Voltage Class C	Mod. Output Pwer	Output from final Pwr Supply	RF Pwer Output	Load on Modulator (ohms)
Unmod Carrier	100 ma	500 v	0 wts	50 wts	35 wts	5000*
Positive Peak	200 ma	1000 v	100 wts	100 wts	140 wts	5000
Negative Peak	0 ma	0 v***	0 wts	0 wts	0 wts	Infinity **

Notes:
* Subject to argument—my opinion!
** Not quite!
*** Plate Voltage at Class C Final plate is zero due to modulator output voltage being equal, but in opposite phase to the power supply voltage.

if undesired transients are to be avoided.

(2) The instantaneous peak power on the "up" peak must quadruple the carrier power. That is, the instantaneous plate current and the instantaneous plate voltage must both double on the upward peak of modulation.

(3) For good quality, any change in instantaneous plate voltage must cause a directly proportional change in plate current. This is known as "linearity."

Since we have said that the Class C final is linear, it behaves like a resistor and ohms law applies, hence the Handbook formula

Modulating Impedance (Load on Modulating Transformer)

$$R = \frac{E}{I} \text{ or } \frac{\text{Plate Voltage}}{\text{Plate Current}}$$

For example, a single 6146 might have a plate voltage of 500 volts and a plate current of 100 ma. The modulating impedance would then be $\frac{500}{100} \times 1000 = 5000$ ohms.

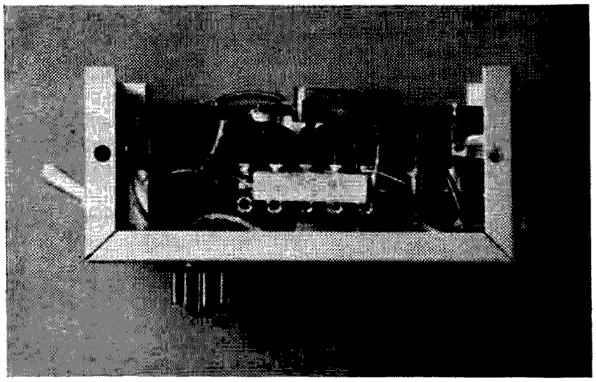
On the upward instantaneous peak of modulation the plate voltage doubles due to addition of voltage from the modulator, or see table.

From this you can see that the Modulator output must vary from 100 watts to zero watts in approximately 1/500 second.

If the modulator tubes are operating in anything other than Class A, then the upward movement of the output is supplied mostly by one tube. Theoretically, in Class B, one tube supplies the upward and the other the downward.

This means that one tube at the positive peak supplies 100 watts. The other tube at the negative peak supplies zero watts. The Class B tubes are unequally loaded.

The regulation of the Class B stage will not



be good. That is the removal of load during part of the cycle will increase the modulator voltage output.

Now let us consider Joe Ham adjusting his transmitter modulation. Using a negative peak indicator, an oscilloscope, or another ham's receiver, he increases the audio input until negative peak overmodulation is just indicated on voice peaks—and he leaves it that. However the negative peaks are distorted, or elongated or accentuated due to the light load on the modulator at this time. The positive peaks are compressed due to the heavy load on the modulator on the upswing. The signal is distorted as in Fig. 1.

Another way of saying this is that the downward percentage of modulation excedes the upward.

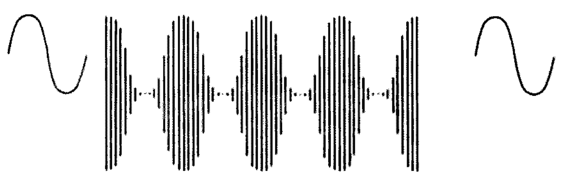


FIGURE IA FIGURE IB FIGURE IC

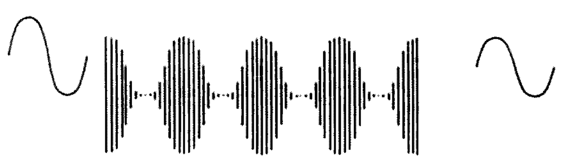


FIGURE ID FIGURE IE FIGURE IF

Fig. 1A: Sine wave modulating signal.
1B: "Perfect" AM. The Carrier varies from zero to twice normal. The Carrier peaks faithfully reproduce 1A.
1C: Demodulated Carrier reproduces 1A.
1D: Input as in 1A.
1E: 100% downward modulation but upward modulation less than 100%.
1F: Resultant demodulated output shows compression of positive peak.
Note: These are voltage or current wave forms, not power.

Several solutions are possible.

(1) Use negative cycle loading.

(2) Use a smaller tube (or a weak one!) for the modulator supplying the down peak.

(3) Use low level half cycle loading to counteract the modulator distortion.

Now back to the "Strange Case of Negative Cycle Loading." If all this was known back in 1959 how come none of the commercial transmitters use it?

Perhaps because as soon as you get control of the negative peaks you find that you need more power from the modulator than can be had in order to get 100% upward modulation. Since Joe Ham is mainly concerned with downward modulation, the smaller commercial transmitters are built to provide more than enough power to downward overmodulate, but upward modulation is somewhat lacking.

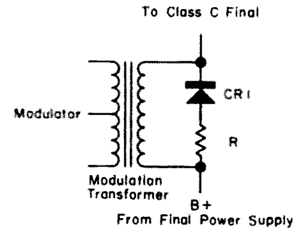


FIGURE 2

Negative Cycle Loading

This is a relatively simple diode and resistor combination (see Fig. 2). On the upward peaks the diode D1 acts as a switch to disconnect resistor R from the modulation transformer secondary. On the downward peaks diode D1 conducts and the load on the transformer secondary cannot decrease below the ohmic value of R.

R is selected experimentally by watching the waveform (wave envelope pattern) on an oscilloscope while talking into the mike. The transmitter af gain control is turned wide open and R is adjusted so that 100% negative modulation just does not occur. This must be done with the final loaded to its normal values.

What occurs in the af section of the transmitter now depends upon the capabilities of the various stages and the circuit position of the gain control. It will probably be found that the audio gain control only increases modulation up to a critical point. Beyond that point overloading occurs and increasing the gain control setting increases distortion but not necessarily power output. In some cases it is possible to increase the B+ to the modulator tubes, which will increase their output, but the actual modulating power is still limited by the capabilities of the modulating transformer. Optimum results occur when the modulation

amplifier is running wide open. Note that this does not necessarily mean gain control at maximum setting.

Since this type of operation results in clipping, very likely in the modulation transformer, some means of suppressing audio harmonics is wise. A condenser of .02 mfd across the modulation transformer secondary is satisfactory. In the Ranger this is already in the transmitter.

Construction

For the Ranger: See Fig. 3 and pictures. The Handibox is 2¼ x 2¼ x 5 inches. Most of the parts mount on a piece of bakelite. The box plugs directly into the external socket on the back of the Ranger—hence the 9 pin plug and jumpers. Phono connectors are used for the external leads to the negative peak indicating meter and for the audio take off for the scope (trapezoidal pattern). To restore the Ranger to normal just replace the original noval plug.

This circuit is more elaborate than necessary since it includes a negative peak overmodulation indicator (to fulfill licensing requirements)

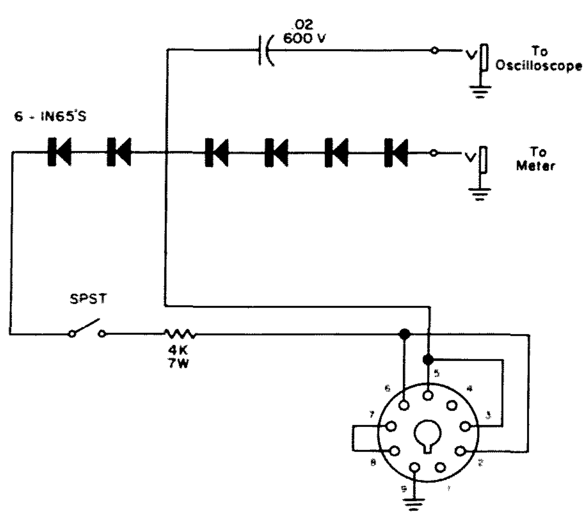
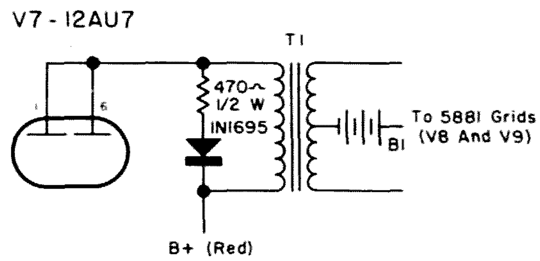


FIGURE 3

and a switch to cut the limiter out to prove to the RI that the indicator is working. With the limiter on the overmodulation indicator never moves off zero.

To attain the required PIV ratings using 1N1695, two in series were used. This could be simplified to one, and a smaller box used by selecting a diode with a higher PIV.

The meter used in the negative peak overmodulation indicator is a one milliamp full scale.



LOW LEVEL LIMITING FOR THE ELMAC AF-67
FIGURE 4

The current shown on the "MOD" position on the Ranger meter switch will be considerably higher than previously. Peaks of 150 ma are not unusual. Bear in mind that any form of clipping frequency shaping or compression is distortion. Do not crowd the mike except under weak signal conditions. But if the lad at the far end is having difficulty, don't be shy.

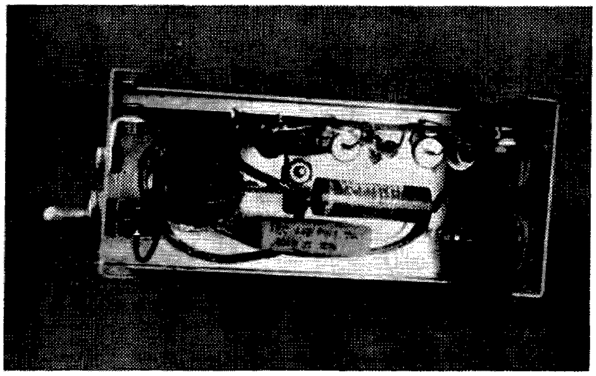
For the Elmac AF67: The same arrangement can be used with the Elmac by addition of the .02 condenser mentioned above. In my case I use a Heath MP1 power supply, and it just couldn't handle the additional power required on voice peaks. So some method of achieving negative peak limiting with less power supply loading was necessary.

The same principle is used, but limiting is applied at a low level point. The Class B modulators are fed a deliberately distorted signal, that is, one whose negative excursions are reduced. The modulator then distorts in the opposite direction. See Fig. 4.

The circuit operates in the same way as the previous one, but is not preferred since it is a compromise which cannot be as accurately established as with the previous method.

The correct connections for the diode should be checked experimentally by use of an overmodulation indicator. If the diode is reversed carrier cutoff will still occur. The resistor value is established by selecting as large a value as possible without permitting carrier cut off under maximum modulation conditions. The two parts can be quite easily mounted under the chassis.

The values arrived at for my Elmac are



shown in Fig. 4, but these may vary in both diode polarity and resistor value depending upon power supply capability transformer T1 and T2 polarities. The circuit shown is a good starting point.

Unsolicited comments such as "You're down to S4 but your audio is still readable" or "You're weak, but I'm reading you OK" are common. It is also some reassurance to know that sudden upheavals in the shack (like dogs and kids) will not give you a signal a yard wide.

. . . VE3AZX

(Editorial note: 73 will welcome articles on the application of this scheme to other commercial rigs plus any other improvements that may be suggested.)

An Answer to "Listen . . . Fellow Radio Amateur"

Donald Carnow K9COG
Chicago, Illinois

The object of this paper is to answer the allegations made against the state of our hobby in "Listen, Fellow Radio Amateur" in the November 73. We hope to clear the confusion created by some writers, and to make us stop and examine the problems facing our community.

To the uncritical reader, "Listen . . . Fellow Radio Amateur" is an impressive article. It is written in a clever style, and nicely uses sagicious sounding words. Its purpose is to impress the reader that some people have an insight into problems and others do not. These people attempt to set themselves above the average ham and try to convince us that they know what is best for Amateur Radio. Such an attitude has been expressed by the members of the Board of the Amateur Radio Relay League. However, before we blindly accept such criticism, let's think about our state of affairs.

The article is inconsistent and the author contradicts himself. He states through implication that the article will e.amine recent criticism with an unprejudiced eye. The reader was initially made to believe that the author would be objective. However, the author goes on and writes as opinionated an article on Incentive Licensing as has yet appeared. He had warned us to be less emotional about the subject and to submit to reason; however, the article was filled with emotional appeals. It uses the techniques of name calling, card stacking, and undocumented testimonals. I contend that such devices need not be used to reveal truth where truth and reason exist.

"Listen . . . Fellow Radio Amateurs" began by citing an ideal definition of Amateur Radio to which we should all theoretically aspire to conform. However, from this very definition, it does not appear that the drafters of the Regulations of the Communications Act wanted to preclude the "communicator" from amateur operations, but the author specifically spoke against the "communicator" as opposed to the technically qualified ham. This F.C.C. definition follows:

> a service of self training, intercommunication, and technical investigation, carried on by amateurs; that is by duly authorized persons interested in radio techniques *solely with a personal aim AND without pecuniary interest.*

Admittedly, reading law is a process of interpretation. However, it is only a supposition that the F.C.C. Regulations had the intentions of preventing the knowledgable communicator from being a ham. If such were the intentions, the F.C.C. license exams would have long ago been made more difficult. The incentive license plan asks for harder examinations. In the light of the above discussion, asking for harder exams only begs the untennable issue of interpretation.

Back Issue

Christmas Bargain

Here is your chance to fill in those missing back issues of 73 and get some delightful reading for the Christmas holidays. It is also an opportunity to send an interesting present to a good friend. Our back issues normally sell for 50¢ each . . . now, until Christmas, December 25, 1963, you can send for back issues at the amazingly low rate of FOUR for $1.00. We will fill your order as requested, but reserve the right to substitute if we should run out of a requested issue. The following are available: 1961 Feb-Dec; 1962 all except June; 1963 all. We will pay $1 each for January 1961 issues in good condition so we can make more bound volumes. This offer for back issues is good only in the U. S. or in Canada if payment is made in U. S. funds. Elsewhere we will have to have postage sent additionally. Figure six ounces per copy.

The first of his errors in logic occurred when the author criticized the current mode of operations by hams when they are on the air or otherwise. I refer to his citing of crowded band conditions, purchase of commercial equipment, and the desire to belong to clubs. All of these were cited as bad practices. However, allow me to justify these conditions. They are all consequences and responses to healthy social conditions. On the first count, every one will admit that ham radio is a popular hobby. Education has progressed to the point where people are better informed today then ever before. With thousands passing the General Class License Exam and wanting to operate, crowded conditions must arise. Secondly, why should one homebrew equipment, when the electronics field has supplied him with kits that save him money?

The desire to belong to clubs should never be considered an absurdity. We as humans are social animals. Everyone of us desires to belong to groups (e.g. families, church groups, clubs, etc.), to see accomplishments of others, and to receive recognition from our peers for our own accomplishments. These are the drives that build well adjusted adults. These are the ends that Amateur Radio provides through similiar interest in communications. We would allow Amateur Radio to exist as an art; but we would not allow it to serve us, if everyone took the attitude of the author of "Listen . . . Fellow Radio Amateur."

Then to add insult to injury the article called the common ham an appliance operator. This is name calling. This type of journalism only clouds the issue and brings about more confusion.

However, the article did not cease ridiculing the amateur operator at this point. After stacking the cards by slanting all the facts to agree with his opinions, the author attacked the ham for some of his idiosyncracies. The author's petty citation of the "break-breaks" and "gimme a clear channel for phone patch" operation, are just a few of the examples.

The critical reader noticed that here the author attacked the operator instead of presenting arguments for his ideas. Very few will deny that it is easier to attack your opponent with insult and emotionally packed words then to logically attack his arguments. In other words, attack the man and not the argument. It is easier and a lot of people are fooled into believing you especially when you have a good vocabulary. Here, again, the argument against or for Incentive Licensing has been confused with someone's emotional drives.

Inconsistencies permeated the entire paper. The following quote from the text should be reviewed:

> "The idea Amateur Radio exists as a hobby is a dangerous one, and a purely amateur concept: to defend . . ."

Do advocates of Incentive Licensing propose that amateurs become non-amateur, or commercial in character?

What motivates the advocates of Incentive Licensing? I do not think it is their altruistic concern for our hobby. In my opinion there are two primary motives:

A. These people are reactionary in character and want to revert back to operating conditions of the early and late 1930's. Such aspirations for uncrowded bands are unrealistic. No one can turn back time. The desire to do so can be interpreted as wanting to satisfy ones ego by bringing back the good old days. In the good old days he was a big wheel and had recognition. Today he is lost in the masses who are also interested in the hobby. He no longer has the recognition that he once had.

B. Superfically, the coming International Conference in Geneva appears as an motive force. However, I consider this a rationalization in the light of the cause stated in A. However, this will be discussed in another paragraph.

Reactionary behavior leads to growth stoppage. The argument of intellectual stimulation not arising from ham radio today is a fallicious one. Intellectual stimulation is relative to the period of time we live in. Considering the many curious items in the field of science, ham radio may not be relatively stimulating today. But it is far advanced on an intellectual basis over 1937.

However, the major indictment of "Listen: Fellow Radio Amateur" has yet to be presented. The author cites several far fetched instances to substantiate his viewpoint. For instance, the author gives the example of the young ham, who was a poor student, to prove the decay of the "art." Also, the "appliance operator" was derogatorily compared to the housewife as being only capable of pushing buttons. Yes, this was scanty the evidence the author gave to substantiate his low opinion of the state of affairs of ham radio.

I submit that these deductions are illogical. Let's stop and think! For example, if a particular person has black hair in a family, does it mean everyone in the family has black hair? If a young ham gets poor grades in school, does it mean that all hams are poor students

or even poor theoreticans? Or if a few hams can't repair their gear themselves, does it mean all hams are not technically inclined? No. No. No. No one has the right to generalize that what may be true for one, ten, or ten thousand is true for all two hundred fifty thousand. Anyone who so reasons only fools himself.

What tickles my funny bone even more is the pseudo-sophisticated attitude of advocates of the Incentive License plan. I especially refer to Board Members of the ARRL, the originators of this farce proposal. These same men who back Incentive Licensing and also accuse the ham of being an appliance operator are responsible for the very condition that they criticize. Rather inconsistent and paradoxical, isn't it?

Our ecenomy is based upon the principle of profit motivation. If an electronics company can run a profitable operation by manufacturing amateur equipment, they are violating no law. However, the manufacturers are stimulus to the so-called "appliance operator" condition. If the ARRL is opposed to the appliance operator, and therefore, commercial equipment, why do they accept the advertising funds of the electronics companies? Their actions certainly contradict their theory in wanting incentive licensing.

It is my belief that the Board of Directors of the ARRL has broken the fiduciary relationship between the ham community and themselves. Why weren't we consulted through opinion surveys in their monthly publications? They say the cost was too high and the time too short. This was an answer from a Chicago resident board member. Well, if one takes an attitude as this, it is primi-facia evidence that they don't know the definition of fiduciary or trust.

In summary I would like to comment on the rationalization referred to above. Obviously the ARRL Board has been procrastinating and now conjecturing about the effect of the Incentive Licensing proposal on the forthcoming international conference in Geneva. Any leverage the ARRL thinks it might acquire by the Incentive Licensing program is strictly imaginary. The rising nations of Africa will not listen to promises or suppositional "ifs." International politics is too complex to reduce the argument of frequency allocations to such simplified terms. We can not equate the international scene and its problems to a mere affirmation or disaffirmation of the Incentive Licensing plan. Decisions will be made upon the basis of politico-economic considerations; not incentive licensing as the ARRL would have you believe.

(W2NSD from page 71)

and adequate documentation to prove that such a trend does exist. This has been one of my main complaints right from the start: the ARRL is proposing legislation without showing that there is any need for it. I have been asking them since last February to provide one single shred of evidence that there is a trend or a need and they have never answered my question.

The Bill Orr article which I printed last month was, unfortunately, a beautiful example of the vagueness and misdirection that is being used to cloud this ARRL move. Bill, who is a good friend of mine, dared me to print his views. I did. But, having been around ham radio for enough years to remember back to the Elysium fields of 1940 to which Bill refers so nostalgically, I can say that I believe things have changed very little. In those days I spent a lot of time going around visiting amateurs and even though more of them built their gear, I don't remember them as the supermen they are billed as today. Though there are no statistics to prove things one way or the other, I remember meeting one ham who had built his own receiver (1940) and I was quite impressed. This was almost unheard of then. He built it from an article in the Handbook and never got it working quite as well as a $29.50 Hallicrafter Skybuddy. I built a receiver in 1937, an all band job from 200 kc to 100 mc. It was lousy. I didn't know any more about radio by 1942 than about 200,000 amateurs today. The Navy put me through their radio and radar school and made me an "expert."

So much for all that hogwash about todays amateurs trending anywhere that requires immediate and drastic regulation changes to correct. I was back there . . . I was one of them . . . don't hand me all that baloney.

Now, to the matter at hand. The FCC is being pressured to push this RM-499 through. If you are opposed then it is up to you to push the other way. You may not care one whit about the philosophical arguments presented, merely being furious about their intended destruction of the Conditional Class license. You may merely disagree with the dictatorial way the ARRL has gone about this. No matter the motivation, this is probably a good time to speak up. Write to the FCC (with original and 14 copies) giving your arguments. Give your Senator or Representative the details on what is happening. Even one of the 15 word Congressman special telegrams for 94c is worth while. If you can't manage to work up 15 copies of your comments then we'll type them up here and run them off for you on our offset press for $2 per double spaced typed page and return 20 copies to you. Your local printer can probably save you time on this . . . and perhaps money.

It is interesting to note that protest hamfests are springing up all around the country. The fellows down in Texas figure they will get between 1500 and 2000 angry amateurs together in Brownsfield on November 9-10. This, together with my mail, would lead me to believe that the "significant percentage" of amateurs who are supporting the League move must be miniscule.

The first IOAR Bulletin is now available. This is a 32 page reprint of the more erudite letters received con and pro the ARRL hassel. It makes fascinating reading. Send a dollar for 12 issues of the Bulletin, or 20c for this single one.

Touring

The first Institute Tour was such a striking success that we are naturally anxious to set up more such trips. We were able to take 73 hams and their wives on four day visits to London, Paris, Geneva, Rome and Berlin with all expenses except lunches and dinners paid for only $560 each. This included hamfests in all except Rome, where we had a personal tour of the Vatican and an audience with the Pope (arranged by Hammarlund), plus guided tours of both West and East Berlin. When you consider that the normal tourist air fare for this trip is $630 and that we traveled by jet everywhere except into Berlin, this is amazing.

Virginia has firmly cancelled my idea of a round-the-world tour for this coming spring, pointing out that I'd do a lot better to devote my time to building up 73 and the Institute instead of trying to make plane, bus and hotel arrangements in fifty different countries. She's right, of course.

This won't stop me from setting up the Scandanavian tour for September and maybe another European tour for October. We'll plan on starting the first tour August 30, with four days each in Oslo, Stockholm, Helsinki, Berlin and Copenhagen. This is the best time of year for a visit to these countries. We'll return September 21st, three weeks later. The cost of the all-expenses (except lunches and dinners) tour will be about $600. This is a lot less than the tourist air fare to Helsinki. This is a little higher than I thought we would have to charge, but I had reckoned without all those airport taxes that other countries charge and little extras for hamfests.

We are planning a second tour of Europe to London, Paris, Geneva, Rome and Berlin

to leave New York on September 27th and return three weeks later on October 19th. This one will also run about $600 unless there are some increases in air fares. We can handle a maximum of 75 hams and wives, so if you are planning on this please let us know as soon as possible. This tour is being planned to coincide with the 1964 Convention of the International Amateur Radio Club in Geneva.

An enterprising amateur is opening a hotel that is particularly aimed at the ham trade. I'll try to have full information on this one by next month. Located on Curacao, it will feature ham shacks for all visiting hams, ham stations on their fleet of boats, instant licensing for visitors, facilities for water skiing, skin diving, fishing, and everything you would expect in a fine resort hotel. If it is at all possible we will arrange a ham tour for this spring to this nearby spot.

. . . Wayne

New Product

The newest toy at 73 Headquarters is our tape embossing machine. This handy little gadget makes raised labels of either one or two lines for marking antenna feedlines, rig controls, and parts cabinets. Virginia has even used it for marking kitchen cannisters and the dog's collar. The adhesive labels stick to almost anything and provide a permanent nameplate.

Best of all, the embosser only costs $5.95 postpaid. Write to Charles Spitz W4API, Box 4095, Arlington, Virginia, 22204.

Culled from the Journals

Who says the professional journals are dry as dust? While searching through the back files of Proceedings of the IRE for an obscure reference on broad-band, ferrite core transformers, the following gem was spotted on page 1383 of the August, 1959 issue. In a submission entitled "Some Notes on Space Communications," John P. Costas writes:

> "Before the author is accused of being a theoretician [5] . . ."
>
> "[5] Theoretician—one who has been trained to assume everything but responsibility."

Incidentally, this boy Costas just doesn't give up. He was the original pusher of double-sideband [1] and in this submission he was right in there pitching on the proper ratio of sideband to carrier power for phase-lock detection.

. . . W4WKM

[1] "Synchronous Communications," Proc. IRE, Vol. 44, PP. 1713-1718, Dec. 1956.

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I certify that the statements made by me above are correct and complete.

(Signature of editor, publisher, business manager, or owner)
(Sgd.) Wayne Green

73 parts kits

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER PREAMPLIFIER. Uses two 6CW4 nuvistors in a grounded grid input circuit (March '63 p8) and one 6CW4 nuvistor grounded grid output. Complete with power supply. Uses 50 volts on the plates for extraordinary noise figure. Full scale drilling template supplied.
W9DUT-1 .... $18.50

QRP TRANSMITTER. Have fun with this little one half watt CW rig on 40 meters. Uses any 40M surplus crystal. Kit supplies 1S4 tube and socket, condensers, resistors, coil, rf choke, terminal trip, etc. Runs from flashlight battery for filament and portable radio 67½ volt B-battery. See March '63 p22
W1MEL $6.00

15-20 METER NUVISTOR PREAMPLIFIER. Need more hop on these bands? This simple to build preamp will bring up those signals. This is particularly good for inexpensive and surplus receivers. See April '63 page 40
W6SFM-1 .... $4.00

TRANSISTOR POWER SUPPLY. Voltage regulater adjustable power supply for running transistor equipment. Takes the strain off those transistor batteries. Great for the test bench. See April '63 page 8. Uses five ransistors, one zener, cute little (expensive) meter, etc. Will deliver up to 100 ma continuously, voltage from 0.35 to 15.0.
W1ISI $25.00

TRANSISTOR TRANSCEIVER. One of the most popular kits we've ever assembled is this six meter miniscule transistorized transceiver. Really works. Hundreds built. See page 8 in the May '63 issue. Five transistors.
K3NHI $25.00

CW MONITOR. Connects right across your key and gives you a tone for monitoring your bug. Page 44, June '63.
WA2WFW $4.25

TWOER MODIFICATION. Increase your selectivity considerably by installing a new triode 7587 nuvistor stage. This is our best selling kit to date. Everything you need for the modification is included. See June '63 page 56
K6JCN $6.50

SIX METER CONVERTER, DELUXE. 6EW6 low noise front end, 6U8 oscillator and mixer. Output is 10.7 mc (easy to change to suit your needs). This is a tunable converter with fixed frequency output, not the usual converter that requires you to tune the receiver. This helps considerably on eliminating interference from nearby high power stations. See page 8, July '63.
W9DUT-2 .... **$20.00**

TUNING EYE KIT. This kit enables you to install a dual tuning eye in any transmitter to indicate the tuning of two or more stages. It works far better than a meter or even meter switching. See page 22, July '63.
K6GKU $7.50

NOISE GENERATOR. Invaluable test instrument for tuning up rf stages, converters, etc., voltage regulated by a ener diode. Kit includes even the battery and mini-box.
K9ONT $5.00

CAST IRON BALUN. Eentsy balun using ferite core, covers 6-40 meters, will handle up to 20 watts, complete with cabinet, connectors, etc. See September 1963 page 8.
W4WKM-1 .... $3.00

BOURBON S-METER. Much better than the usual Scotch S-meter. Here is an S-meter kit for those of you with receivers without S-meters. Includes tube, adjusting pot., socket, resistors, and meter. See September 1963 page 18.
W6TKA-2 .... $6.50

TONE MODULATED CRYSTAL STANDARD. Uses one tube and one mc crystal to generate 1 mc markers all the way up through 225 mc. The built in tone generator makes it possible to easily identify the markers. Including Minibox, tube, vrystal, etc. See Oct. '62 p 26.
W9DUT-3 .... $15.00

TRANSISTORIZED MODULATOR. 40 watt modulator, excellent for plate modulating mobile rigs, four transistors, uses 12 volts dc, only draws 250 ma while resting with peaks of 4-5 amperes. Kit includes transistors, transformers, resistors, condensers, etc. See Sept. 62 p 24.
VE7QL $27.50

SHORT WAVE CONVERTER FOR HAMBAND RECEIVERS. One tube short wave converter so you can tune SW broadcast stations. Power supply included. See Aug. 62 p 38.
W2LLZ $13.00

WRETCHED K2PMM

BADGES $1.00 each.

One of the big problems at hamfests and club meetings is to have everyone plainly enough marked with their first name and call. All sorts of stickers and pieces of cardboard have been tried, plus little cards which can be typed up and stuck in holders . . . all have the same problem: they are hard to read from any distance.

The best answers to date are these engraved laminated plastic name badges which can be read by Cousin Weakeyes from seventeen paces. You are in luck. We've arranged to make these darbs available at a real low price, all personally engraved. The badges are 3" x ¾" and come complete with a pin and safety lock. Please give your first name, call and specify whether you want the badge to be bright red with white letters or jet black with white letters.

Order from

73 Peterborough, N. H.

OTHER 73 BULLETINS AND BOOKS

6UP Magazine. Now in its fifth month with back issues getting rarer and rarer. This VHF monthly magazine is edited by Jim Kyle K5JKX and presents up to the minute reports on activities on all VHF and UHF bands, technical articles of interest to VHF'ers, and other general information not to be found elsewhere. This is the only strictly VHF magazine being published now. If you are a VHF'er you won't want to miss a single issue of 6up . . . you should support it. Subscriptions are only $2 per year, back issues are available at present for those who would like a retroactive subscription.

ATV Bulletin. In direct refutation to the ARRL claim that amateurs are lagging technically are the 2000 readers of the semi-monthly Amateur Television Experimenter Bulletin, edited by W0KYQ. If you are at all interested in amateur television you should subscribe to ATV, the only source of operating and technical info on this amazing branch of our hobby. Back issues are virtually all sold out, so don't put off subscribing. $1 a year for six issues.

5-7-9 Bulletin. Editor is that well known old time contester W1AER. This bulletin, published monthly, lists every contest known to exist for the following two months, giving the rules for those which probably will not appear in QST or CQ and the results wherever available. The bulletin is leading a lively discussion of recent rule changes on ARRL contests, and other matters of interest to contesters and certificate seekers. $2.00 a year.

73 News. Published monthly, editor VE3DQX. Keeps you up-to-date on current ham events. Invaluable to club officials for discussions at club meetings. Good source material for club bulletins. 1.00/year.

Ham-RTTY. This is the most complete book on the subject. Written for the beginning TT'er as well as the expert. More complete and authoriative than books at twice the price. Pictures and descriptions of all popular machines, where to get them, how much, etc. $2.00

Bound Volume 2. Complete library volume containing the 1962 issues of 73. $15.00

Binders. Bright red leather binding. Specify which year you want stamped on them: 60-1, 62, 63. Darbs. $3.00 each.

Care and Feeding of Ham Clubs—K9AMD. Carole did a thorough research job on over a hundred ham clubs to find out what aspects went to make them successful and what seemed to lead to their demise. This book tells all and will be invaluable to all club officers or anyone interested in forming a successful ham club. Hundreds of grateful letters have been received from clubs who have applied the ideas in this book. $1.00

Simplified Math for the Hamshack—K8LFI. This is the simplest and easiest to fathem explanation of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc. If our schools ever got wind of this amazing method of understanding basic math our kids would have a lot less trouble. 50¢

Index to Surplus—W4WKM. This is a complete list of every article ever published on the conversion of surplus equipment. Gives a brief rundown on the article and source. $1.50

Ham-TV—WØKYQ. Covers the basics of ham-TV, complete with how to get on the air for under $50. Not the usual theory manual, but a how-to-do-it book. $3.00

Surplus TV Schematics. You can save a lot of building time in TV if you take advantage of the real bargains available in surplus. This book gives the circuit diagrams and info on the popularly available surplus TV gear. $1.00

AN/ARC-2 Conversion. This transceiver sells in the surplus market for from $40 to $50 and is easily converted into a fine little ham transceiver. Covers 29 mc (160-80-75-40 meters). This booklet gives you the complete schematic and detailed conversion instructions. $1.00

AN/VRC-2 Conversion. Completely different from the ARC-2. This book gives you complete instructions on converting the inexpensive VRC surplus gear into a six meter wide band FM transceiver. There are probably over a thousand stations now operating on 52.525 mc around the country. Join the crowd. Fun. $1.00

Coils—K8BYN. Basic book which covers the theory and practical aspects of the many different types of coils found in ham work. Well illustrated. 50¢

CW—W6SFM. Anyone can learn the code. This book, by an expert, lays in a good foundation for later high speed CW ability. 50¢

3D Map of World. Maybe you've been eating your heart out for one of these beautiful relief maps after seeing one at a friend's shack. Comes complete with one year subscription or extension to 73. $9.95

3D Map of U. S. Complete with one year sub to 73. $9.95

Mickey Miker—WØOPA. Complete instructions for building a simple precision capacity tester. Illustrated. 50¢

Frequency Measuring—WØHKF. Ever want to set yourself up to measure frequency right down to the gnat's eyebrow? An expert lets you in on all of the secrets. Join Bob high up on the list of Frequency Measuring Test winners. $1.00

Impedance Bridge. Full scale construction prints for the bridge described in the August 1961 issue of 73. Comes complete with a reprint of the article. Watch out General Radio! $1.00

SSB Transceiver Schematic—W6BUV. Giant size schematic of the transceiver that appeared in the November 1961 issue of 73. Complete with extra November issue. $1.00

Radio Bookshop

DEAR SANTY

Mr. Claws is now working up here at Radio Bookshop and hopes that you will do everything you can to make your own Xmas happy by sending some loot up here for a few books to keep you busy over those holidays.

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. **$12.00**

11—16TH EDITION RADIO HANDBOOK—by Bill Orr W6SAI. This fantastic book is loaded with the most understandable theory course now available in our hobby plus dozens of great construction projects. This is the best ham handbook in print by a wide margin. Easily worth twice the price. **$9.50**

13—REFERENCE DATA FOR RADIO ENGINEERS. Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. **$6.00**

16—HAM REGISTER—Lewis (W3VKD). Thumbnail sketches of 10,000 of the active and well known hams on the air today. This is the Who's Who of ham radio. Fascinating reading. Only edition. Now only **$2.50**

18—SO YOU WANT TO BE A HAM—Hertzberg (W2DJJ). Second edition. Good introduction to the hobby. Has photos and brief descriptions of almost every commercially available transmitter and receiver, plus accessories. Lavishly illustrated and readable.. **$2.95**

21—VHF HANDBOOK—Johnson (W6-QKI). Types of VHF propagation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. **$2.95**

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, to install it, how to tune it. **$2.70**

23—NOVICE & TECHNICIAN HANDBOOK—Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license and build a station. **$2.85**

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. **$2.85**

26—S9 SIGNALS—Orr (W6SAI). A manual of practical detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. **$1.00**

27—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction, and operation of cubical quads. Build-it yourself info. Feed systems, tuning. **$2.85**

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. **$1.75**

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. **$7.50**

36—CALL LETTER LICENSE PLATE—Regulation size license plate. Please give your call and the color of letters and background. **$3.00**

37—101 WAYS TO USE YOUR HAM TEST EQUIPMENT—Middleton. Grid-dip meters, antenna impedance meters, oscilloscopes, bridges, simple noise generators, and reflected power meters are covered. Tells how to chase trouble out of ham gear. 168 pages. **$2.50**

49—ELECTRONIC COMMUNICATION—Shroder. Huge book aimed at giving all information necessary for FCC Commercial and amateur licenses. **$13.00**

52—HOW TO READ SCHEMATIC DIAGRAMS—Marks. Components & Diagrams; electrical, electronic, ac, dc, audio, rf, TV. Starts with individual circuits and carriers through complete equipments. **$3.50**

55—TRANSISTOR CIRCUIT HANDBOOK—Simple, easy to understand explanation of transistor circuits. Dozens of interesting applications. **$4.95**

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Propagation Charts

J. H. Nelson

EASTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7	7	7	7	7	7	7	7	7*	14	14	14
ARGENTINA	14	14	7*	7	7	7	14	21	21	21	21*	21
AUSTRALIA	14	7*	7	7	7	7	7	14	14	14	14*	21
CANAL ZONE	7*	7	7	7	7	7	14	21	21	21	21*	14
ENGLAND	7	7	7	7	3.5	7	14	14*	14*	14	7	7
HAWAII	14	7	7	7	7	7	7	7	14	21	21	14*
INDIA	7	7	7	7	7	3.5	7*	14	7*	7	7	7
JAPAN	7*	7	7	7	7	7	3.5	7	7	7*	7	14
MEXICO	14	7	7	7	7	7	7	14	21	21	21	14
PHILIPPINES	7*	7	7	7	7	7	3.5*	7	7	7*	7	7
PUERTO RICO	7	7	7	7	7	7	14	14	14	14*	14*	14
SOUTH AFRICA	7*	7	7	7	7	7	14	21*	21	21	14	14
U.S.S.R.	7	7	7	7	7	3.5	7*	14	7*	7	7	7

CENTRAL UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7	7	14	14	14
ARGENTINA	14	14	7*	7*	7	7	7	14	21	21	21*	21
AUSTRALIA	21	14	7	7	7	7	7	7	14	14	14*	21
CANAL ZONE	14	7*	7*	7*	7	7	7	14	21	21*	21*	21
ENGLAND	7	7	7	7	3.5	3.5	7	14	14	7*	7	7
HAWAII	14	7*	7	7	7	7	7	7	14	21	21	21
INDIA	7	7	7	7	7	7	3.5	7	7	7*	7*	7
JAPAN	14	7*	7	7	7	7	7	7	7	7*	7	14
MEXICO	7*	7	7	7	7	7	7	14	14	14	14*	14
PHILIPPINES	14	7*	7	7	7	7	7	7	7	7*	7	14
PUERTO RICO	7*	7	7	7	7	7	14	21	21	21*	21*	14
SOUTH AFRICA	7*	7	7	7	7	7	14	14	21*	21	21	14
U.S.S.R.	7	7	7	3.5	7	7	3.5	7*	7	7	7	7

WESTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7	7	7*	14	14
ARGENTINA	14	7*	7	7	7	7	7	14	21	21	21*	21*
AUSTRALIA	21	14	7*	7	7	7	7	7	7*	14	14*	21
CANAL ZONE	14	14	7	7	7	7	7	14	21	21	21*	21
ENGLAND	7	7	7	7	3.5*	3.5*	3.5	7	14	7	7	7
HAWAII	21	14	7*	7	7	7	7	7	7*	14	21	21
INDIA	7*	7	7	7	7	7	7	7	7	7	7*	7*
JAPAN	14*	14	7	7	7	7	7	7	7	7*	7	14
MEXICO	14	7	7	7	7	7	7	7	14	14*	21	14*
PHILIPPINES	14*	14	7*	7	7	7	7	7	7	7*	7	14
PUERTO RICO	14	7	7	7	7	7	7	14	21	21*	21*	14
SOUTH AFRICA	7*	7	7	7	7	7	7	7*	14	21	21	14
U.S.S.R.	7	7	7	3.5	7	7	7*	7	7	7	7	7

* Means next higher frequency might be useful.

Items of Interest

The fine article "Why Johnny Ham Can't Hear" by W6VAT in the October issue of 73 should be read by all amateurs. This article goes a long way toward explaining the difficulties and dangers of frequency predicting.

It also points out why amateurs, working on low power, should work as close to the MUF as possible. There is less noise and less adsorption on the higher frequencies.

The asterisks (*) in the frequency prediction charts show what hours of the day it might be more profitable to go up one band in frequency. A 21* means that if 28 is going to get through at all, this is the best time of day to try it. It probably will not be very active at this part of the sunspot cycle.

Good: 2-4, 10-11, 15-18
Fair: 1, 5, 9,14, 19, 24-28
Poor: 6-8, 12-13, 20-23, 29-31
Es: 5-6, 14-16 (High MUF and/or freak conditions)

(dis) similar

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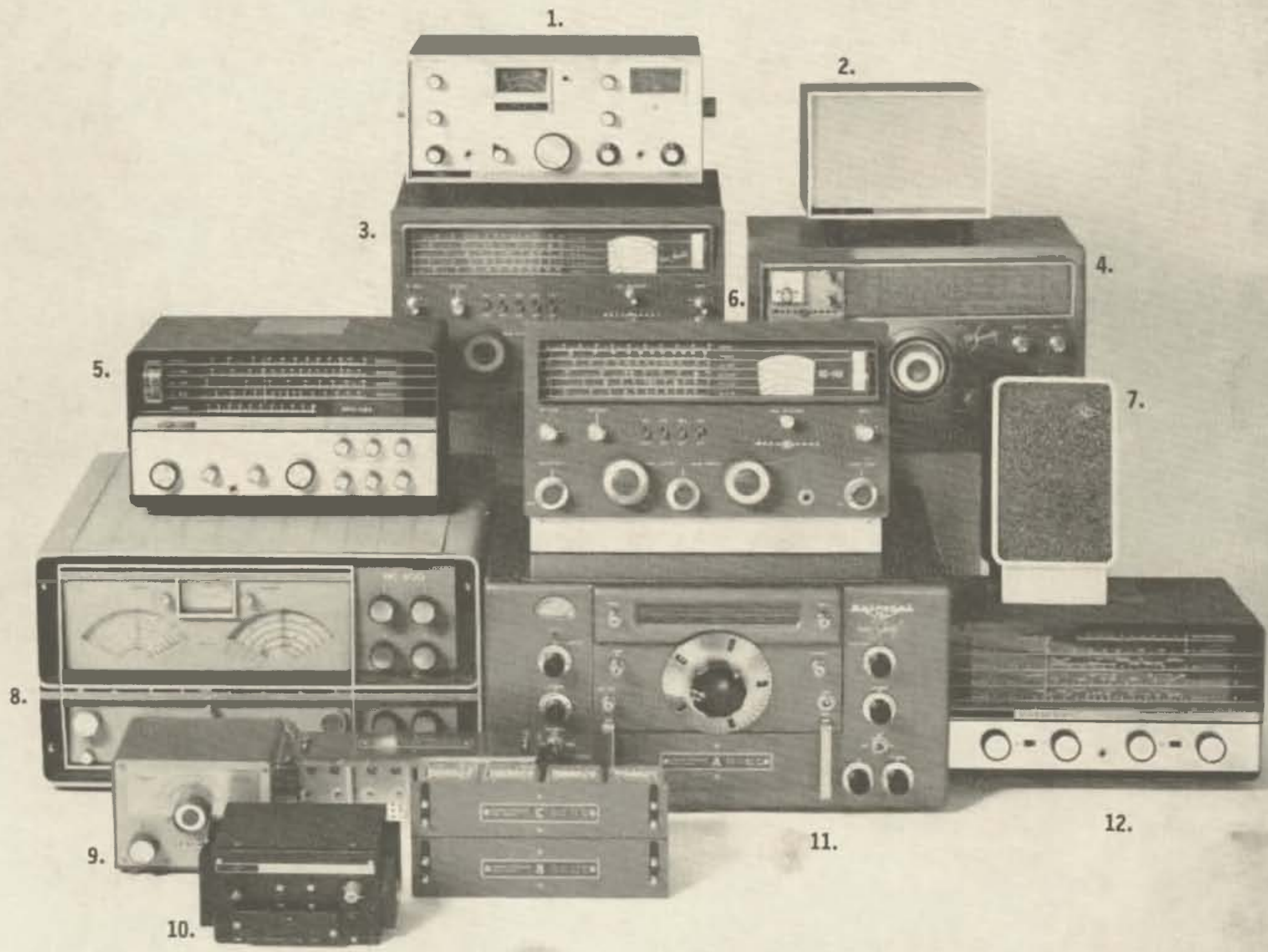

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